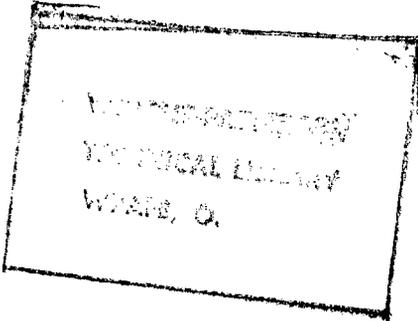


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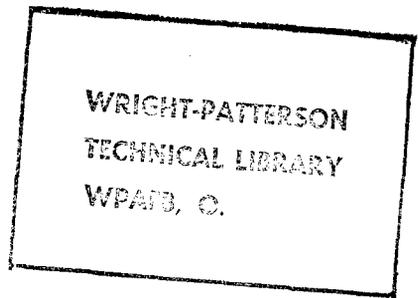
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ANTHROPOMETRY OF FLYING PERSONNEL - 1950



H. T. E. HERTZBERG
G. S. DANIELS

AERO MEDICAL LABORATORY

AND

E. CHURCHILL

ANTIOCH COLLEGE

SEPTEMBER 1954

Statement A
Approved for Public Release

WRIGHT AIR DEVELOPMENT CENTER

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ANTHROPOMETRY OF FLYING PERSONNEL - 1950

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Aero Medical Laboratory

and

E. Churchill

Antioch College

September 1954

Aero Medical Laboratory
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Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio

FOREWORD

The work described herein was carried out by the Anthropology Section, Biophysics Branch, Aero Medical Laboratory, under the authority of Research and Development Order R-695-71, 'Anthropometry of USAF Personnel', and at Antioch College, Yellow Springs, Ohio under Contract AF 18(600)-30.

The program was initiated by Mr. H. T.E. Hertzberg, Chief, Anthropology Section. He and his assistant, Lt. G. S. Daniels, USAF (MSC), organized the program, selected the itinerary, planned the measuring routine, and trained the teams. They alternately supervised the survey during its tour.

Upon completion of field work in August 1950, statistical reduction of the data was begun at Antioch College. Lt. Daniels was appointed project director for the Anthropology Section and Mr. Edmund Churchill was named Principal Investigator for the Contract by Antioch College. Since that time, the conduct of the program has rested largely in their hands.

The organization and accomplishment of a program of this type requires the aid of many persons and agencies. It is not possible to mention by name all of the individuals who helped to 'get the show on the road' and keep it there, but we are grateful to all of them for their fulfillment of our numerous needs. Special thanks, however, are due to Colonel Walter A. Carlson, then Chief, Aero Medical Laboratory (Dec. 1949), whose understanding and approval of the program and staunch support at critical moments, made the entire undertaking possible. We are also grateful to Colonel A. P. Gage

and Colonel H.M. Sweeney for their aid in inaugurating the program.

We are indebted to the Commanding Officers and staffs of Barksdale, Bergstrom, Brooks, Ellington, Fairfield-Suisan, Lackland, Lowry, March, Mather, McChord, Randolph, Selfridge, Spokane, and Westover Air Force Bases for their friendly and helpful reception, and to their respective Commands for permission to visit these Bases.

In addition, we feel deeply grateful to the 4,000 men who submitted themselves to "the fastest and most thorough going-over they'd ever had". They were friendly and cooperative throughout.

James Bohle, Donald Clark, Niel Fetter, Charles Grover, Richard Kalish, Gordon Guenther, Kenneth Kreitner, Richard O'Kane, George Saunders, Robert Smith, Paul Taberski, and Keith Taylor, members of the measuring team, deserve special thanks for the excellent and sustained job they did.

The authors are grateful to the Contractor's staff for their handling of the millions of calculations needed in a work of this size. In particular, thanks are due Mrs. Virginia Brown, Mrs. Sheryl Worrall, and Mr. Irvin Emanuel. Thanks are also due Mr. Frank P. Saul of the Anthropology Section for his help, and Mrs. Cleona Allen for preparing the visual index. The editorial skill and care of Mr. H. Lee Jones and Mrs. Marjorie Martin, both of the Aero Medical Laboratory, were especially valuable in readying the report for the printer, and the authors are grateful for their aid.

ABSTRACT

Body size data for 132 measurements of over 4,000 Air Force flying personnel are presented. Organization of the survey is briefly discussed and the techniques of measurement are illustrated by photographs for the benefit of other anthropologists. Both diametral and surface measurements are included. Dimensions are given in both centimeters and inches.

A description of the statistics and an explanation of their use are given with some discussion of certain statistical shortcuts employed in the reduction of the data. The tabulations include range, mean, standard deviation, coefficient of variation, and twenty-five selected values from the first to the ninety-ninth percentile. Means and standard deviation values for each dimension are also given for nine subgroups based on flight duties.

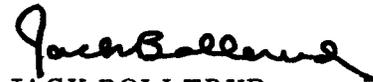
A Glossary and Bibliography are included.

These data are presented for use by the designers of aircraft, clothing and equipment.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:



JACK BOLLERUD
Colonel, USAF (MC)
Chief, Aero Medical Laboratory
Directorate of Research

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INTRODUCTION

The Anthropometric Survey Team of 1950 visited fourteen Air Force Bases and took 132 body measurements, some sociological data and four somatotype photographs of each of more than 4,000 Air Force personnel in all flight categories. The authors believe this to be the greatest number of measurements ever taken on so large a series of subjects. Although most of the measurements are considered conventional by physical anthropologists, approximately 35 are believed to be entirely new.

Numerous surveys had been taken in the past, some large ones relatively recently, on both Air Force and Ground Forces personnel. Many persons asked, why was this new survey necessary? Why would not former surveys suffice? Why so many subjects? And why so many bases? Reflection showed that there were several reasons for a new survey. The main reason lay in the immediate need for entirely new information about bodily dimensions. Rapid developments in aircraft had resulted in physiological stresses on crewmen undreamed of only ten years before. To counteract these stresses a skin-tight garment had to be worn. The loosely-fitted flying clothing of World War II had been adequately designed by the use of conventional body diameters and segment lengths taken at that time—stature, shoulder breadth, chest depth, sitting height, arm length, etc.—but obviously a skin-tight garment would demand something further. New measurements would have to be developed to find out how a man's skin fits him. Furthermore, because such clothing was intended only for Air Force flying personnel—a group highly selected by various criteria from the population at large—the new survey would have to be limited to that group. And finally, the Air Force sample measured would have to be large enough for an accurate appraisal of the full range of air crew body size. Considering the expense of procuring a skin-tight garment, anything less might have been false economy. The risk involved in basing such a procurement on an inadequate

sample was clearly too great.

The present volume contains only the main summary statistics and percentiles of the dimensions of the total series and its subgroups, with the necessary supporting descriptions of techniques and statistical procedures. While this information is immensely valuable in direct application by designers of machinery, clothing, and personal equipment, it is not all that can be extracted from the raw data of the Survey. Further statistical studies are planned to investigate the generalities of body configuration, and the relations between dimensions of various segments, especially with regard to physical type. These will be published as they are completed.

The text and tables of this volume have been painstakingly scrutinized many times for errors, but in a work of this magnitude some mistakes must still be present. The authors will be grateful to have them pointed out as they are found.



Figure 1 - Location of Bases

SECTION I- THE SURVEY

Sixteen Air Force Bases, well scattered about the United States, were selected for a team visit, the planned sample to number about 5,000 men. As a result of the Communist invasion of Southern Korea on 25 June 1950, just when the Survey was in full swing, the Survey had to be terminated when only 80% complete. Two bases were not visited. As it turned out, the 4,000 man sample thus obtained was adequate for most purposes.

The Air Force Bases to be visited were chosen with care. For one thing, time was limited by the period of team availability. Then, too, for scientific adequacy as well as economy, each base selected had to provide enough subjects to justify the expense of a visit and, from an overall view, the personnel it furnished had to be of the proper flight categories needed for adequate Air Force representation. (For breakdown by aero-ratings see Section III.)

The bases visited had to be widely distributed throughout the country because regional differences in body type are known to exist over the United States, and, during peace time, men tend to seek assignment to military installations near their homes. While the need for this last precaution could not be conclusively demonstrated prior to the Survey, enough indications of its desirability existed to justify some expense as an experiment to evaluate the need of selecting bases throughout the country, both for the present and future surveys. (The precaution of diversity was later found to be justified. See Appendix B, "The Sample".) The tour covered approximately three-quarters of the United States.

In organizing the measuring routine, the central thought was to reduce the waste motion of measuring operations to a minimum. While new measurement techniques were being devised, old tech-

niques were analyzed as motion-and-time problems, then redesigned to eliminate the making and breaking of the anthropometer, to minimize the picking-up and laying-down of instruments, changing of subject postures, and the like. Generally, the sequence of measurement was from the top downward and outward, in logical progression, for any body member.

Most of the measurements taken were conventional body diameters or segment lengths, well known to anthropologists and adequately described in the literature. These were retained not only because they afford standards of comparison between the present sample and previous samples similarly measured, but because many such measurements, such as stature and hip breadth, have direct utility at any time.

About thirty-five measurements, designed to answer specific or anticipated Air Force needs, were quite new. From a functional standpoint, one fault of previous surveys was the measurement of the body in a fixed and sometimes unnatural posture, without consideration for its ability to move and stretch. Since any skin-tight garment must obviously allow for body stretch, mobility of the shoulders, elbows, and knees had to be taken into account. In addition, some body measurements were taken to indicate the 'space envelope' through which a man moves to perform his flight tasks.

The field data blank (Figure 2) was designed for the eventual transfer of all information to I. B. M. punch cards for statistical analysis. Because any information punched into a card is readily extracted regardless of where it is punched, measurements on the field blank did not have to be grouped according to anatomical areas or planned use of material. Position of a measurement on the blank was intended solely for ease and efficiency of use by the record-

ANTHROPOMETRIC SURVEY BLANK

No.

1	2	3	4
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OBSERVATION CODE DATE

LOCATION

NAME
last first middle

SERIAL NO.

5 RANK

6 AERO. RATING

7, 8 AGE (last birthday)

9 BIRTHPLACE of SUBJECT (State, if U.S.A.; or country if foreign)

10 BIRTHPLACE—FATHER " " " " " " "

11 BIRTHPLACE—MOTHER " " " " " " "

12 RELIGION (Protestant¹, Catholic², Jewish³, other⁴)

13 EDUCATION (Highest grade completed) (read and write¹, grade school², high school³, special training [tech., bus., etc.]⁴, college⁵, professional⁶)

14 MARITAL STATUS (single¹, married², divorced or separated³, widower⁴)

15 RACE (White¹, Negro², Indian³, Mongoloid⁴, other⁵)

DO NOT WRITE BEYOND THIS LINE

- 16 HAIR COLOR (blk.¹, dk. br.², br.³, red br.⁴, fld. br.⁵, ash br.⁶, golden⁷, ash⁸, red⁹, white¹⁰, graying¹²)
- 17 HAIR FORM (straight¹, low wave², deep wave³, curly⁴, frizzly⁵)
- 18 SKIN COLOR (pale¹, med. pink², ruddy³, brunet⁴, swarthy⁵, yellow brown⁶, dk. brown⁷, black⁸)
- 19 BODY HAIR QUANTITY (absent¹, sm.², +³, ++⁴, +++⁵)
- 20 EYE COLOR—Non-pigmented (dk. blue¹, med. blue², lt. blue³, gray-blue⁴, gray⁵)
- 21 EYE COLOR—Mixed (dk. blue¹, med. blue², lt. blue³, gray⁴, gray-gn.⁵, green⁶, yellow⁷, orange⁸, lt. brown⁹, dk. br.¹⁰)
- 22 EYE COLOR—Pigmented (lt. brown¹, red brown², dk. brown³, black⁴)

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No.

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	Substernale	Suprasternale	Penale	First Phalanx III
WEIGHT				
NECK CIRC.				
SHOULDER CIRC.				
CHEST CIRC.				
WAIST CIRC.				
BUTTOCK CIRC.				
THIGH CIRC.				
LOWER THIGH CIRC.				
CALF CIRC.				
ANKLE CIRC.				
BALL OF FOOT CIRC.				
ARM SCYE				
AXILLARY ARM CIRC.				
BICEPS CIRC. (FLEXED)				
ELBOW CIRC. (FLEXED)				
LOWER ARM CIRC. (FLEXED)				
WRIST CIRC.				
GLOVE SIZE				
SLEEVE INSTAN.				
SLEEVE LENGTH				
SHOULDER LENGTH				
WAIST BACK				
WAIST FRONT				
GLUTEAL ARC				
CROTCH LENGTH				
VERTICAL TRUNK CIRC.				
HEAD CIRC.				
SCAPITAL ARC				
CORONAL ARC				
MINIMUM FRONTAL ARC				
BITRAGON-MIN. FRONTAL ARC				
BITRAGON-CRINION ARC				
BITRAGON-MENTON ARC				
SUB-MANDIBULAR ARC				
BITRAGON-SUBNASALE ARC				
POSTERIOR ARC				
BITRAGON-IONION ARC				
INTERSCYE (S)				
INTERSCYE MAXIMUM (S)				
HIP CIRC. (S)				
KNEE CIRC. (S)				
STATURE				
TRAGON HT.				
INTERNAL CANTHUS HT.				
NASAL ROOT HT.				
CERVICALE HT.				
ACROMIAL HT.				
NIPPLE HT.				
LAT. HUMERAL EPICONDYLE HT.				
WAIST HT.				
RADIALE HT.				
METACARPALE RAD. HT.				
GLUTEAL SEAM HT.				
CROTCH HT. (UNSEAM)				
PATELLA HT.				
SITTING HT.				
INTERNAL CANTHUS HT. (S)				
ACROMIAL HT. (S)				
WAIST HT. (S)				
ELBOW HT. (S)				
THIGH HT. (S)				
KNEE HT. (S)				
POPULITEAL HT. (S)				
BUTTOCK-KNEE LENGTH				
SHOULDER-ELBOW LENGTH				
FOREARM LENGTH				
ELBOW BREADTH				
HIP BREADTH (S)				
KNEE BREADTH (S)				
BUTTOCK-LEG LENGTH				
BIACROMIAL DIA.				
BIDELTOID DIA.				
CHEST WIDTH				
WAIST WIDTH				
HIP WIDTH (STANDING)				
CHEST DEPTH (A. P.)				
WAIST DEPTH (A. P.)				
BUTTOCK DEPTH (A. P.)				
SPAN				
HAND LENGTH				
HAND BREADTH AT META.				
HAND BREADTH AT THUMB				
THICKNESS AT META. III.				
PALM LENGTH				
FINGER CIRC. (III)				
GRIP				
GRIP DIA.				
HEIGHT OF LAT. MALLEOLUS				
HEIGHT OF MED. MALLEOLUS				
BI-MALLEOLAR WIDTH				
HEEL WIDTH				
FOOT WIDTH				
INSTEP LENGTH				
FOOT LENGTH				
HEAD LENGTH				
HEAD BREADTH				
MINIMUM FRONTAL DIA.				
MAXIMUM FRONTAL DIA.				
BIZYGOMATIC DIA.				
BIGONIAL DIA.				
BITRAGON DIA.				
BIGOCULAR DIA.				
INTEROCULAR DIA.				
INTERPUPILLARY DISTANCE				
NASAL LENGTH				
NASAL BREADTH				
NASAL ROOT BREADTH				
NASAL HEIGHT				
PHILTRUM HT.				
MENTON-SUBNASALE HT.				
CRINION-MENTON HT.				
MOUTH HT.				
MOUTH BREADTH				
EAR HEIGHT				
EAR BREADTH				
EAR HT. ABOVE TRAGON				
EAR PROTRUSION				
MENTON PROJECTION				
ANTERIOR NECK LENGTH				
POSTERIOR NECK LENGTH				
AURICULAR HT.				
ARM LENGTH TO WALL				
MAX REACH FROM WALL				
FUNCTIONAL REACH				
WALL TO EXT. CANTHUS				
WALL TO NASAL ROOT				
WALL TO TRAGON				
WALL TO LARYNX				
SOMATOTYPE—1ST COMPONENT				
2ND COMPONENT				
3RD COMPONENT				
GYANDROMORPHY				
DYSPLASIA				

Figure 2 - Survey Blank

er, so that tape measurements appear in one column and caliper measurements in another.

Head measurements are noted in a number of places. Similarly, measurements on standing subjects are found in different places on the blank from those made on sitting subjects, even though the same type of instrument was used in both cases. In a few instances, mistakes of item placement were found after the blanks were printed. Requirements for four new measurements were realized after the blanks were printed. These additional data were simply written in at convenient locations on the blank.

A survey of this magnitude obviously could not have been carried out by the Anthropology Section alone, as it consisted of only two physical anthropologists at that time. A source of manpower had to be found.

After a considerable but fruitless search for academic anthropological departments interested in such a program, a contract was let to Antioch College, Yellow Springs, Ohio, for the services of twelve untrained students to form a measuring team and for subsequent statistical reduction of the data gathered. To use the students, the tour had to be within the period the men could spend away from classes.

Team training was intensive. Each man was measured by the supervisors, then he, in turn, had to demonstrate repeatedly his ability to match these measurements on each of his fellows. Practice went on for eight hours a day. The men were subdivided into six pairs, each pair to specialize in a specific series of measurements. Within one week every man knew his job and the team departed on its scheduled tour.

On the road, the complete survey team consisted of a supervisor, a photographer, and the six pairs of measurers. Each pair had its portion of the field blank to fill in, these portions having been planned to require equal periods of time

for their completion. Each man alternated between measuring and recording at about two hour intervals to minimize fatigue. A subject being measured carried his blank along from one group to the next in 'production-line' fashion, having his measurements filled in at each stop, and finally relinquishing the completed form to the photographer who took four photographs of him to complete the record.

When working at peak speed it was possible to process subjects at the rate of approximately 170 in a seven-hour day, or one man every 2,5 minutes. Such exhausting occasions, however, were not normal throughout the Survey. In general, the schedules were held to about 100 to 120 subjects daily.

The standard anthropometric instruments (Figure 3) were supplemented by measuring-board techniques to satisfy the requirement of speed with accuracy.

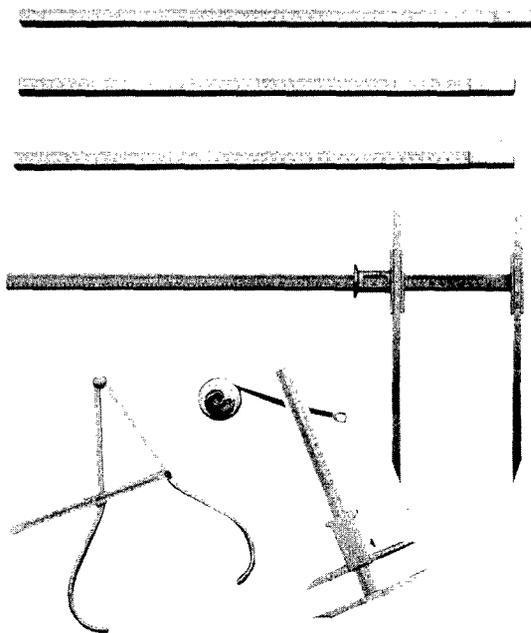


Figure 3 - Anthropometric Instruments

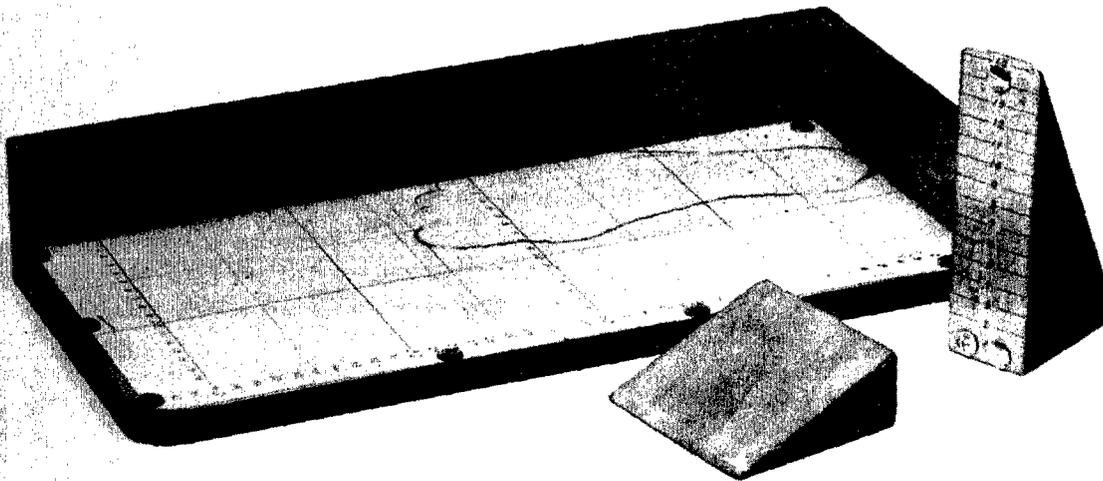


Figure 4 - Foot Measuring Block

Grid sheets graduated in centimeters and millimeters were prepared so they could be tacked on the wall at a known distance from the corner of a room. By such means, span and the several arm lengths were taken without the clumsily-held anthropometers. Foot width, foot length, and instep length were similarly taken with a special box. Ankle heights were taken by means of a block with a millimeter scale mounted along the vertical edge (Figure 4).

Finger diameter was quickly and accurately obtained by a series of graded holes in a sheet of plastic, and

grip diameter was measured with a graduated cone (Figure 5).

As a further aid to measuring, certain points and lines were marked on the subjects' bodies with wax pencil to facilitate and standardize the location of anatomical points by the six measuring pairs. These marks, made by the first pair, eliminated the need for any palpation or further searching for these points by the other five pairs. The location of the points is described in Appendix A 'Glossary and Marked Points' and illustrated there in Figure 8.

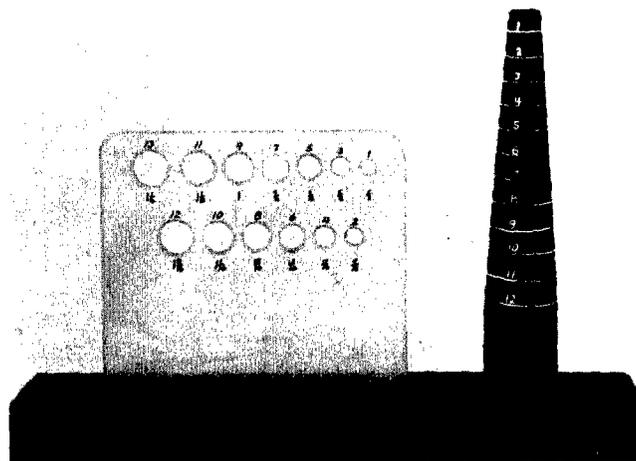


Figure 5 - Finger Board and Measuring Cone

Descriptions of the exact techniques of measurement accompany the statistical summaries in Section II. The techniques are further illustrated there by photographs and schematic drawings.

In preparing these descriptions, an effort has been made to achieve a balance between the oft times conflicting desires for descriptions written in ordinary, nontechnical language, and for descriptions which are anthropologically precise. Sometimes general terms are followed by technical ones placed in parentheses as, for example, 'bottom of the nose (subnasale)'. In all such instances, the technical term is to be understood as taking precedence over the nontechnical term whenever there is any conflict between the two. In some cases, the precise location of a point (e.g., end of the ulnar styloid process) is followed by a further and, perhaps, redundant general location of the point (e.g., at the little finger side of the wrist). In a few cases (e.g., shoulder height), it was felt that the title would serve as a general description of the dimension being measured and that a somewhat technical description would suffice.

Undoubtedly these efforts to write descriptions which would satisfy both engineers and clothing designers on the one hand and anthropologists on the other has not been uniformly successful. It is hoped that readers from each of these groups will realize the necessity of considering the needs of the other group at this point, as well as at other points, in the preparation of this report.

All technical terms used in these descriptions are defined in the glossary. It should be noted that 'stands erect' and 'sits erect' are here considered technical terms; the glossary should be consulted for their exact meanings.

Nontechnical titles have been used whenever short and reasonably precise ones were available. Such titles have not been found for all dimensions, this being particularly true of the head dimensions. It is hoped that the visual index and the extensive cross-indexing in the regular index will enable the reader to find any dimension, no matter what sort of a title it

may have.

It appeared particularly important that titles which suggest anything to the layman should not suggest the wrong thing. 'Sleeve length' seemed thoroughly imbedded in the literature of the clothing trade and 'head height' too imbedded in the literature of anthropometry to be dropped, therefore, both have been given parenthetical modifiers to warn the lay person of what these terms are not.

The word 'height' has been reserved, with the exception just mentioned, for dimensions measured vertically from the floor, the sitting surface, or the footrest surface. All straightline right-to-left measurements are designated as breadths or, in certain cases, diameters. Front-to-back measurements on the torso are called 'depths'.

The dimensions tabulated in this report are intended to represent closer approximations to body surfaces than have hitherto been available. Dimensions of body segments have been tied to other dimensions of the body as a whole, so there are fewer "floating" zones, i. e., body zones whose positions in space are unknown because they have not been related to known anatomical points. But even where both diameters and circumferences are available, the shape of the surface is still not known—consider the complicated topography of the head and face—so it is clear that entirely novel techniques must be developed for a more accurate delineation of body form. Research in the field of measurement is continuing toward the ideal of a complete metrical specification of the body surface. Once the human topography with its variability is statistically known, a reasonable approximation to body size and shape for any application will become possible as a starting point for design.

The reader may wonder why dimensions are given in both metric and English systems. Anthropologists generally use the former, while engineers in the United States use the latter almost exclusively. Because this report is intended to be of use to both groups, both systems have been presented.

Section II
TOTAL GROUP OF FLYING PERSONNEL

	Page		
WEIGHT	11		
BODY LENGTHS		CIRCUMFERENCES AND BODY SURFACE MEASUREMENTS	
Stature	11	Neck Circumference	33
Tragion Height	12	Shoulder Circumference	34
Eye Height	12	Chest Circumference	34
Nasal Root Height	13	Waist Circumference	35
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Chest Breadth	30	THE HAND	
Waist Breadth	31	Hand Length	52
Hip Breadth	31	Hand Breadth at Metacarpale	52
Chest Depth	32	Hand Breadth at Thumb	53
Waist Depth	32	Thickness at Metacarpale III	53
Buttock Depth	33	Palm Length	54

First Phalanx III Length	54	Lip-to-Lip Distance	65
Finger Diameter III	55	Lip Length (Bichelion Diameter)	66
Grip Diameter (Inside)	55	Ear Length	66
Grip Diameter (Outside)	56	Ear Breadth	67
Fist Circumference	56	Ear Length above Tragion	67
		Ear Protrusion	68
THE HEAD AND FACE		Head Height	68
Head Length	57	Menton Projection	69
Head Breadth	57	External Canthus to Wall	69
Minimum Frontal Diameter	58	Nasal Root to Wall	70
Maximum Frontal Diameter	58	Tragion to Wall	70
Bizygomatic Diameter	59	Larynx to Wall	71
Bigonial Diameter	59	Head Circumference	71
Bitragion Diameter	60	Sagittal Arc	72
Biocular Diameter	60	Bitragion-Coronal Arc	72
Interocular Diameter	61	Minimum Frontal Arc	73
Interpupillary Distance	61	Bitragion-Minimum Frontal Arc	73
Nose Length	62	Bitragion-Crinion Arc	74
Nose Breadth	62	Bitragion-Menton Arc	74
Nasal Root Breadth	63	Bitragion-Submandibular Arc	75
Nose Protrusion	63	Bitragion-Subnasale Arc	75
Philtrum Length	64	Bitragion-Posterior Arc	76
Menton-Subnasale Length	64	Bitragion-Inion Arc	76
Menton-Crinion Length	65		

The material presented on the following pages consists of descriptive statistics for a series of 132 measurements made on a group of over 4,000 Air Force flying personnel.

The design engineer will find here a comprehensive set of data providing detailed information applicable to many problems of human fit, whether of clothing, personal equipment, or some phase of the ever-increasing man-machine complex. This information is meant to be used, not stored away as an impressive collection of mathematical tables.

Some familiarity with simple statistics, however, is desirable in the use of these tables. Once the engineer becomes familiar with the nature of the statistical information available for each measurement, he should encounter no trouble in applying this material. For those who are not already acquainted with means, standard deviations, percentiles, etc., a few minutes devoted to Section IV, "De-

scription and Use of Statistics", should suffice to explain the meanings and uses of these terms.

Since most users of this report will not be anthropologists, a description, photograph and schematic drawing of the measurement accompanies each set of data.* Thus each set of data can be used without any need to refer to other pages of this or other reports for a full understanding and utilization of the material. A glossary of technical terms is given in Appendix A.

*Further comment is needed on one measurement: buttock-leg length. Many subjects could not flatten the knee to the table while keeping the buttocks against the wall. The resulting measured values may fall somewhat short of the theoretical dimensions. They are considered valid, however, for cockpit design purposes.

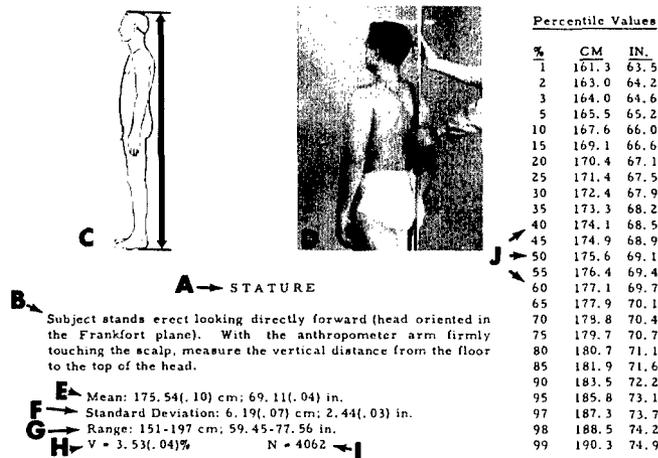


Figure 6 - Typical Layout

Figure 6 shows a typical layout in this first data section. "A" is the Title of the measurement being described. "B" is a Written Direction for the taking of the measurement. "C" is a Line Drawing of a subject with the measurement shown schematically as a dimensioning arrow, or, in the case of circumferences, as a black band. A straight dimensioning arrow indicates a straight-line, point-to-point measurement. A curved dimensioning arrow indicates a body surface measurement, that is, one made between two points but following the actual surface of the body rather than a straight line.

"D" is a Photograph of the measurement being made on a subject. In many cases this serves to show more anatomical detail of the specific location of the measurement plus the actual use of the anthropometric instrument concerned.

"E" is the Mean of the measurements recorded for all the subjects considered in the preparation of these tables. The Standard Error of the Mean is given in parentheses immediately following the value of the mean itself. Thus, the mean of the statures is 175.54 centimeters with a standard error of 0.10 centimeters or, equivalently, 69.11 inches with a standard error of 0.04 inches.

An alternative method of presenting standard errors is to precede them by a plus-or-minus sign. Readers accustomed to this method should recognize that 69.11(0.04) inches, as used here, and 69.11 ± 0.04 inches are absolutely identical in meaning.

"F" is the Standard Deviation of the measurements, also followed, in parentheses, by its Standard Error. "G" is the Range of the measured values. "H" is the Coefficient of Variation, designated, as is usual, by the letter V, and followed by its Standard Error. "I" is the number of men considered in preparing these tables.

"J" is the Percentile Table. Standard errors for the percentiles are not given here but can be obtained from a table which appears elsewhere in this report. The mean, standard deviation, range, and percentiles are given in both metric and English units.

The statistics presented in Section III are based on the same data as are those of this Section. In Section III, however, these data have been broken up into subgroups based on the type of duty performed in the air by the measured men.

WEIGHT

Subject determined his own weight on standard military (medical type) scales.

Percentile Values

<u>Percentile</u>	<u>Pounds</u>	<u>Percentile</u>	<u>Pounds</u>
1%	123.1	55%	164.5
2%	126.2	60%	167.2
3%	129.3	65%	170.4
5%	132.5	70%	173.6
10%	138.3	75%	176.6
15%	142.1	80%	180.9
20%	145.5	85%	186.0
25%	148.7	90%	192.6
30%	151.0	95%	200.8
35%	154.2	97%	206.2
40%	156.6	98%	211.6
45%	159.4	99%	215.9
50%	161.9		

Mean: 163.66(.33) lbs.

Standard Deviation: 20.86(.23) lbs.

Range: 104-265 lbs.

V = 12.74(.14)%

N = 4052

BODY LENGTHS



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	161.3	63.5
2	163.0	64.2
3	164.0	64.6
5	165.5	65.2
10	167.6	66.0
15	169.1	66.6
20	170.4	67.1
25	171.4	67.5
30	172.4	67.9
35	173.3	68.2
40	174.1	68.5
45	174.9	68.9
50	175.6	69.1
55	176.4	69.4
60	177.1	69.7
65	177.9	70.1
70	178.8	70.4
75	179.7	70.7
80	180.7	71.1
85	181.9	71.6
90	183.5	72.2
95	185.8	73.1
97	187.3	73.7
98	188.5	74.2
99	190.3	74.9

STATURE

Subject stands erect looking directly forward (head oriented in the Frankfort plane). With the anthropometer arm firmly touching the scalp, measure the vertical distance from the floor to the top of the head.

Mean: 175.54(.10) cm; 69.11(.04) in.

Standard Deviation: 6.19(.07) cm; 2.44(.03) in.

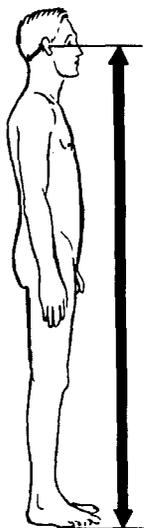
Range: 151-197 cm; 59.45-77.56 in.

V = 3.53(.04)%

N = 4062

Percentile Values

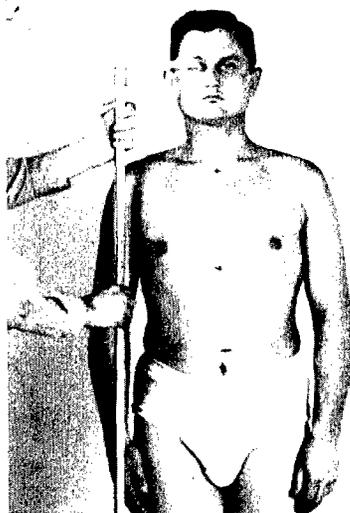
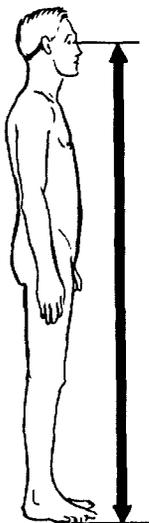
%	CM	IN.
1	148.4	58.4
2	150.2	59.1
3	151.3	59.6
5	152.4	60.0
10	154.6	60.9
15	156.1	61.5
20	157.3	61.9
25	158.3	62.3
30	159.2	62.7
35	160.1	63.0
40	161.0	63.4
45	161.8	63.7
50	162.5	64.0
55	163.2	64.2
60	163.9	64.5
65	164.7	64.8
70	165.5	65.2
75	166.4	65.5
80	167.4	65.9
85	168.6	67.0
90	170.2	67.0
95	172.2	67.8
97	173.9	68.5
98	175.0	68.9
99	176.9	69.6



TRACION HEIGHT

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the anthropometer, measure the vertical distance from the floor to the cartilaginous notch (tracion) just forward of the upper edge of the right ear hole.

Mean: 162.36(.10) cm; 63.92(.04) in.
 Standard Deviation: 6.07(.07) cm; 2.39(.03) in.
 Range: 139-189 cm; 54.72-74.41 in.
 V = 3.74(.04)% N = 4063



Percentile Values

%	CM	IN.
1	150.3	59.2
2	152.1	59.9
3	153.1	60.3
5	154.4	60.8
10	156.5	61.6
15	158.0	62.2
20	159.2	62.7
25	160.3	63.1
30	161.3	63.5
35	162.1	63.8
40	163.0	64.2
45	163.7	64.4
50	164.4	64.7
55	165.1	65.0
60	165.9	65.3
65	166.7	65.6
70	167.5	66.0
75	168.4	66.3
80	169.3	66.7
85	170.5	67.1
90	172.1	67.7
95	174.3	68.6
97	175.8	69.2
98	176.8	69.6
99	178.5	70.3

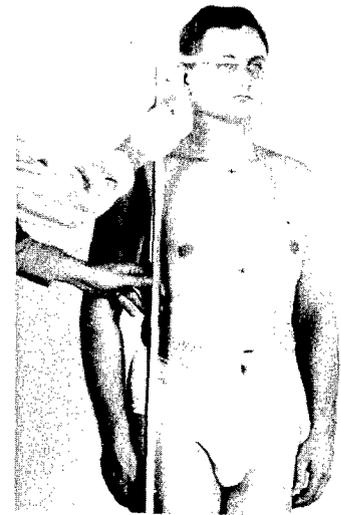
EYE HEIGHT (INTERNAL CANTHUS HEIGHT)

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the anthropometer, measure the vertical distance from the floor to the inner corner of the right eye (internal canthus).

Mean: 164.31(.09) cm; 64.69(.04) in.
 Standard Deviation: 6.04(.07) cm; 2.38(.03) in.
 Range: 143-186 cm; 56.30-73.23 in.
 V = 3.68(.04)% N = 4063

Percentile Values

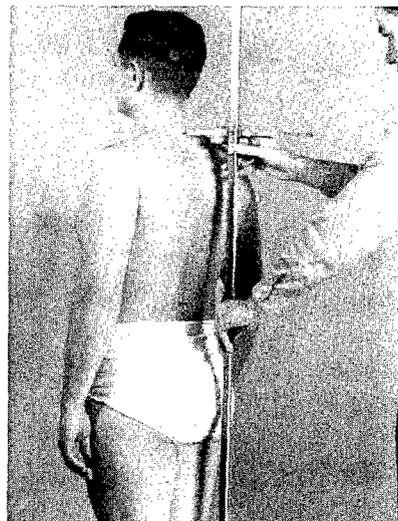
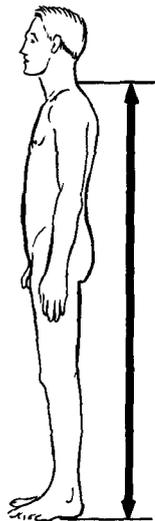
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	150.9	59.4
2	152.6	60.1
3	153.7	60.5
5	155.0	61.0
10	157.2	61.9
15	158.7	62.5
20	159.9	62.9
25	161.1	63.4
30	161.9	63.7
35	162.8	64.1
40	163.6	64.4
45	164.3	64.7
50	165.0	65.0
55	165.8	65.3
60	166.5	65.6
65	167.4	65.9
70	168.2	66.2
75	169.0	66.5
80	169.5	66.9
85	171.0	67.4
90	172.7	68.0
95	175.1	68.9
97	176.4	69.4
98	177.4	69.8
99	179.6	70.7



NASAL ROOT HEIGHT

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the anthropometer, measure the vertical distance from the floor to the point of greatest indentation where the nose meets the forehead (nasal root).

Mean: 164.97(.10) cm; 64.95(.04) in.
 Standard Deviation: 6.06(.07) cm; 2.39(.03) in.
 Range: 143-186 cm; 56.30-73.23 in.
 V = 3.67(.04)% N = 4063



CERVICALE HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the point marked on the posterior base of the neck (bony bump formed by the 7th cervical vertebra).

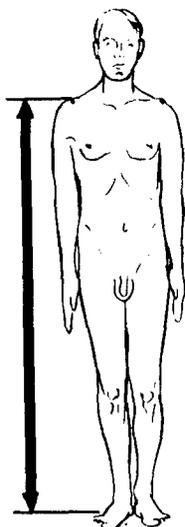
Mean: 150.07(.09) cm; 59.08(.04) in.
 Standard Deviation: 5.87(.06) cm; 2.31(.02) in.
 Range: 128-170 cm; 50.39-66.93 in.
 V = 3.91(.04)% N = 4062

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	136.3	53.7
2	138.0	54.3
3	139.0	54.7
5	140.4	55.3
10	142.5	56.1
15	144.0	56.7
20	145.1	57.1
25	146.2	57.6
30	147.1	57.9
35	147.9	58.2
40	148.8	58.6
45	149.5	58.9
50	150.2	59.2
55	150.9	59.4
60	151.7	59.7
65	152.4	60.0
70	153.1	60.3
75	153.9	60.6
80	154.9	61.0
85	156.2	61.5
90	157.6	62.0
95	159.7	62.9
97	161.2	63.5
98	162.3	63.9
99	164.0	64.6

Percentile Values

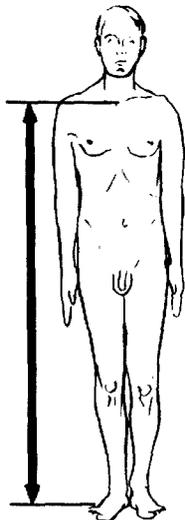
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	130.1	51.2
2	131.7	51.9
3	132.7	52.2
5	134.1	52.8
10	136.0	53.5
15	137.5	54.1
20	138.6	54.6
25	139.6	55.0
30	140.5	55.3
35	141.4	55.7
40	142.2	57.0
45	142.9	56.3
50	143.7	56.6
55	144.4	56.8
60	145.1	57.1
65	145.8	57.4
70	146.6	57.7
75	147.3	58.0
80	148.3	58.4
85	149.5	58.9
90	151.0	59.4
95	153.0	60.2
97	154.5	60.8
98	155.6	61.3
99	157.1	61.9



SHOULDER HEIGHT (ACROMIAL HEIGHT)

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to right acromion as marked.

Mean: 143.51(.09) cm; 56.50(.04) in.
 Standard Deviation: 5.80(.06) cm; 2.28(.02) in.
 Range: 120-163 cm; 47.24-64.17 in.
 V = 4.04(.04)% N = 4063



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	130.4	51.3
2	131.8	51.9
3	132.7	52.2
5	133.8	52.7
10	135.9	53.5
15	137.3	54.1
20	138.4	54.5
25	139.4	54.9
30	140.1	55.2
35	140.9	55.5
40	141.6	55.8
45	142.4	56.0
50	143.1	56.3
55	143.7	56.6
60	144.3	56.8
65	145.0	57.1
70	145.7	57.4
75	146.6	57.7
80	147.6	58.1
85	148.8	58.6
90	150.2	59.1
95	152.1	59.9
97	153.5	60.4
98	154.5	60.8
99	156.2	61.5

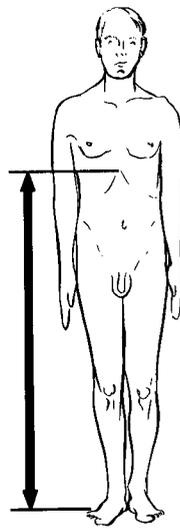
SUPRASTERNALE HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the marked point at the upper edge of the breastbone (suprasternale).

Mean: 142.95(.09) cm; 56.28(.04) in.
 Standard Deviation: 5.56(.06) cm; 2.19(.02) in.
 Range: 122-162 cm; 48.03-63.78 in.
 V = 3.89(.04)% N = 4062

Percentile Values

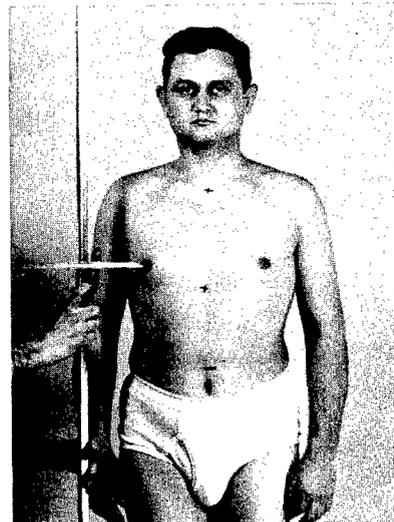
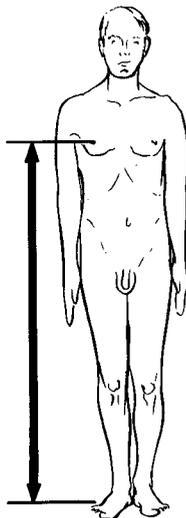
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	111.7	44.0
2	113.4	44.6
3	114.4	45.0
5	115.7	45.6
10	117.2	46.1
15	118.5	46.7
20	119.5	47.1
25	120.3	47.4
30	121.1	47.7
35	121.9	48.0
40	122.5	48.2
45	123.1	48.5
50	123.8	48.7
55	124.4	49.0
60	125.0	49.2
65	125.7	49.5
70	126.4	49.8
75	127.2	50.1
80	128.1	50.4
85	129.1	50.8
90	130.4	51.3
95	132.3	52.1
97	133.6	52.6
98	134.6	53.0
99	136.0	53.5



SUBSTERNALE HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the marked point at the lower edge of the breastbone (substernale).

Mean: 123.72(.09) cm; 48.71(.04) in.
 Standard Deviation: 5.13(.06) cm; 2.02(.02) in.
 Range: 105-141 cm; 41.34-55.51 in.
 V = 4.15(.05)% N = 2950



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	115.9	45.6
2	117.4	46.2
3	118.3	46.6
5	119.5	47.0
10	121.2	47.7
15	122.6	48.3
20	123.6	48.7
25	124.5	49.0
30	125.4	49.4
35	126.1	49.6
40	126.8	49.9
45	127.5	50.2
50	128.1	50.4
55	128.8	50.7
60	129.5	51.0
65	130.1	51.2
70	130.9	51.5
75	131.6	51.8
80	132.5	52.2
85	133.5	52.6
90	134.9	53.1
95	136.8	53.9
97	138.3	54.4
98	139.2	54.8
99	140.5	55.3

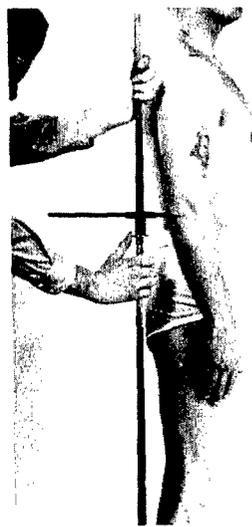
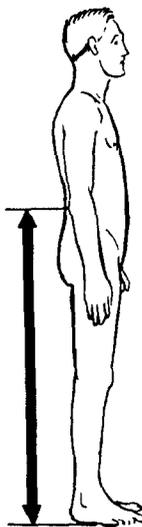
NIPPLE HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the center of the right nipple.

Mean: 128.05(.08) cm; 50.41(.03) in.
 Standard Deviation: 5.29(.06) cm; 2.08(.02) in.
 Range: 107-145 cm; 42.13-57.09 in.
 V = 4.13(.05)% N = 4059

Percentile Values

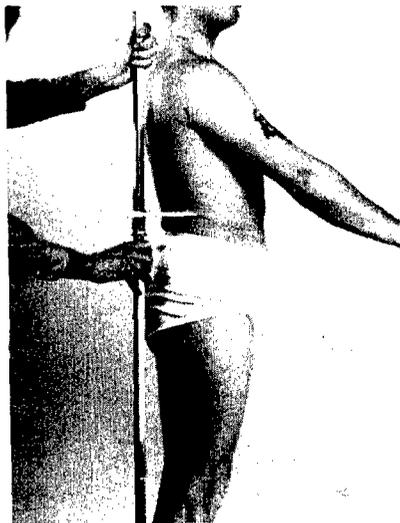
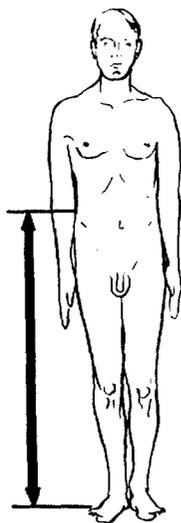
%	CM	IN.
1	100.4	39.5
2	101.4	39.9
3	102.2	40.2
5	103.2	40.6
10	104.8	41.3
15	105.8	41.6
20	106.6	42.0
25	107.4	42.3
30	108.1	42.6
35	108.8	42.8
40	109.4	43.1
45	110.0	43.3
50	110.5	43.5
55	111.1	43.7
60	111.7	44.0
65	112.3	44.2
70	112.9	44.4
75	113.6	44.7
80	114.3	45.0
85	115.2	45.4
90	116.3	45.8
95	117.9	46.4
97	119.1	46.9
98	119.9	47.2
99	121.2	47.7



ELBOW HEIGHT (RADIALE HEIGHT)

Subject stands erect, his arms hanging naturally at his sides. Using the anthropometer, measure the vertical distance from the floor to the depression between the humerus and radius of the right arm. This depression can be seen in the lateral side of the elbow.

Mean: 110.48(.07) cm; 43.50(.03) in.
 Standard Deviation: 4.50(.05) cm; 1.77(.02) in.
 Range: 93-125 cm; 36.61-49.21 in.
 V = 4.06(.05)% N = 4063



Percentile Values

%	CM	IN.
1	95.8	37.7
2	97.2	38.3
3	98.1	38.6
5	99.3	39.1
10	101.0	39.8
15	102.1	40.2
20	102.9	40.5
25	103.6	40.8
30	104.4	41.1
35	105.2	41.4
40	105.7	41.6
45	106.3	41.8
50	106.8	42.1
55	107.4	42.3
60	108.0	42.5
65	108.6	42.7
70	109.2	43.0
75	109.8	43.2
80	110.5	43.5
85	111.4	43.9
90	112.6	44.3
95	114.3	45.0
97	115.7	45.6
98	116.6	45.9
99	117.9	46.4

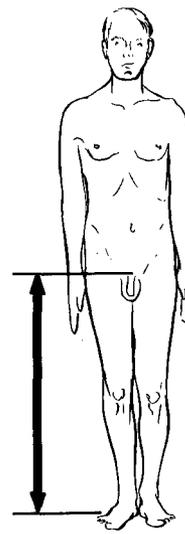
WAIST HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the waist point marked on the right side.

Mean: 106.74(.07) cm; 42.02(.03) in.
 Standard Deviation: 4.61(.05) cm; 1.81(.02) in.
 Range: 88-124 cm; 34.65-48.82 in.
 V = 4.32(.05)% N = 4063

Percentile Values

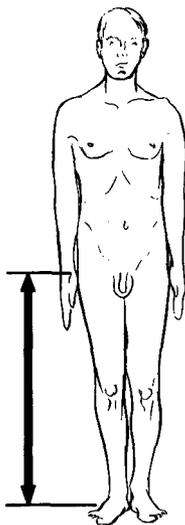
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	77.6	30.6
2	78.7	31.0
3	79.4	31.3
5	80.3	31.6
10	82.0	32.3
15	83.2	32.7
20	84.1	33.1
25	84.8	33.4
30	85.5	33.6
35	86.1	33.9
40	86.5	34.1
45	87.0	34.3
50	87.6	34.5
55	88.2	34.7
60	88.8	35.0
65	89.5	35.2
70	90.1	35.5
75	90.7	35.7
80	91.5	36.0
85	92.3	36.4
90	93.5	36.8
95	95.1	37.4
97	96.2	37.9
98	97.0	38.2
99	98.3	38.7



PENILE HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the upper edge of the junction of the penis with the abdomen.

Mean: 87.69(.08) cm; 34.52(.03) in.
 Standard Deviation: 4.45(.06) cm; 1.75(.02) in.
 Range: 71-105 cm; 27.95-41.34 in.
 V = 5.07(.07)% N = 2951



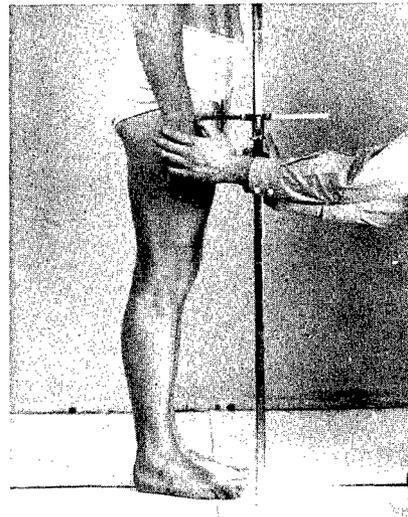
WRIST HEIGHT (STYLION HEIGHT)

Subject stands erect, his arms hanging naturally at his sides. Using the anthropometer, measure the vertical distance from the floor to the notch beyond the radial styloid process of the right arm.

Mean: 85.15(.06) cm; 33.52(.02) in.
 Standard Deviation: 3.92(.04) cm; 1.54(.02) in.
 Range: 70-101 cm; 27.56-39.76 in.
 V = 4.60(.05)% N = 4063

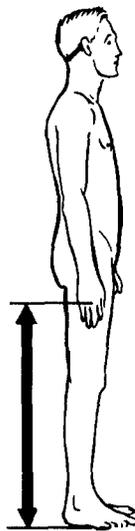
Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	76.4	30.1
2	77.3	30.4
3	77.9	30.7
5	78.7	31.0
10	80.1	31.5
15	81.1	31.9
20	81.9	32.2
25	82.5	32.5
30	83.1	32.7
35	83.7	33.0
40	84.3	33.2
45	84.8	33.4
50	85.2	33.6
55	85.7	33.7
60	86.2	33.9
65	86.7	34.1
70	87.3	34.4
75	87.8	34.6
80	88.5	34.9
85	89.3	35.2
90	90.2	35.5
95	91.6	36.1
97	92.5	36.4
98	93.2	36.7
99	94.3	37.1



Percentile Values

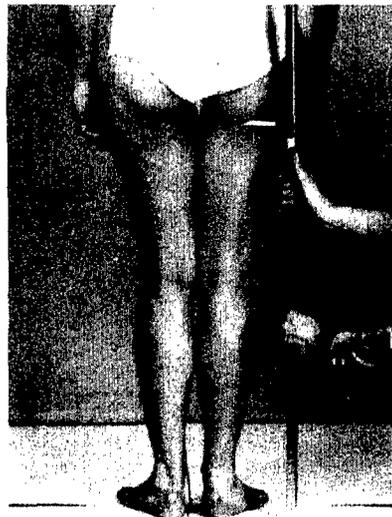
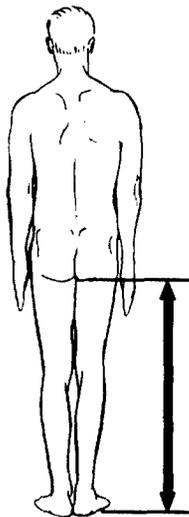
%	CM	IN.
1	67.9	26.7
2	68.9	27.1
3	69.5	27.4
5	70.3	27.7
10	71.6	28.2
15	72.5	28.5
20	73.2	28.8
25	73.8	29.1
30	74.4	29.3
35	74.9	29.5
40	75.4	29.7
45	75.9	29.9
50	76.3	30.0
55	76.7	30.2
60	77.2	30.4
65	77.7	30.6
70	78.3	30.8
75	78.8	31.0
80	79.4	31.3
85	80.1	31.5
90	81.1	31.9
95	82.4	32.4
97	83.3	32.8
98	84.0	33.1
99	85.1	33.5



**KNUCKLE HEIGHT
(METACARPALE III HEIGHT)**

Using the anthropometer, measure vertically from the floor to the largest knuckle of the right hand where the first phalanx of the middle finger joins the corresponding bone of the palm (third metacarpal).

Mean: 76.29(.06) cm; 30.04(.02) in.
 Standard Deviation: 3.69(.04) cm; 1.45(.02) in.
 Range: 63-89 cm; 24.80-35.04 in.
 V = 4.84(.05)% N = 4059



GLUTEAL FURROW HEIGHT

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the lowest point where the buttock curve and the back of the thigh join.

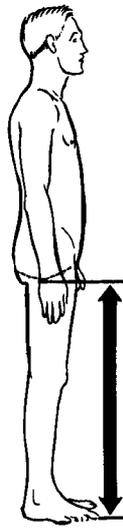
Mean: 80.18(.06) cm; 31.57(.02) in.
 Standard Deviation: 4.12(.05) cm; 1.62(.02) in.
 Range: 64-94 cm; 25.20-37.01 in.
 V = 5.14(.06)% N = 4063

Percentile Values

%	CM	IN.
1	70.9	27.9
2	72.0	28.3
3	72.6	28.6
5	73.6	29.0
10	75.0	29.5
15	76.0	29.9
20	76.8	30.2
25	77.5	30.5
30	78.1	30.7
35	78.6	30.9
40	79.1	31.2
45	79.7	31.4
50	80.2	31.6
55	80.7	31.8
60	81.2	32.0
65	81.8	32.2
70	82.4	32.4
75	83.0	32.7
80	83.7	33.0
85	84.5	33.3
90	85.5	33.7
95	87.0	34.3
97	88.1	34.7
98	88.9	35.0
99	90.1	35.5

Percentile Values

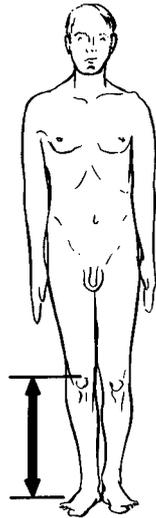
%	CM	IN.
1	74.3	29.3
2	75.5	29.7
3	76.3	30.0
5	77.3	30.4
10	77.8	30.6
15	79.0	31.1
20	79.8	31.4
25	80.5	31.7
30	81.2	32.0
35	81.8	32.2
40	82.3	32.4
45	82.8	32.6
50	83.3	32.8
55	83.9	33.0
60	84.5	33.3
65	85.1	33.5
70	85.8	33.8
75	86.4	34.0
80	87.1	34.3
85	88.0	34.6
90	89.1	35.1
95	90.6	35.7
97	91.8	36.1
98	92.6	36.5
99	93.9	37.0



CROTCH HEIGHT (INSEAM)

Subject stands erect, his legs slightly apart. Hold the anthropometer vertically in front of the subject and raise the instrument arm between the scrotum and right leg. Have the subject bring his heels together and raise the instrument arm until it firmly presses against the flesh of the midpoint of the crotch. Record the indicated distance from the floor.

Mean: 83.40(.07) cm; 32.83(.03) in.
 Standard Deviation: 4.39(.05) cm; 1.73(.02) in.
 Range: 68-97 cm; 26.77-38.19 in.
 V = 5.26(.06)% N = 4062



Percentile Values

%	CM	IN.
1	45.4	17.9
2	46.1	18.1
3	46.6	18.3
5	47.1	18.4
10	48.1	18.9
15	48.7	19.2
20	49.2	19.4
25	49.6	19.5
30	50.0	19.7
35	50.3	19.8
40	50.7	20.0
45	51.0	20.1
50	51.3	20.2
55	51.7	20.3
60	52.0	20.5
65	52.4	20.6
70	52.8	20.8
75	53.2	20.9
80	53.6	21.1
85	54.2	21.3
90	54.8	21.6
95	55.7	21.9
97	56.4	22.2
98	56.9	22.4
99	57.6	22.7

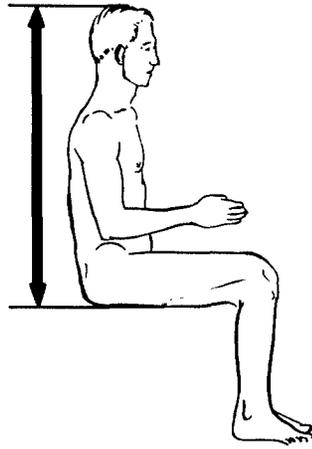
KNEECAP HEIGHT (PATELLA HEIGHT)

Subject stands erect. Using the anthropometer, measure the vertical distance from the floor to the uppermost point of the right kneecap.

Mean: 51.35(.04) cm; 20.22(.02) in.
 Standard Deviation: 2.61(.03) cm; 1.03(.01) in.
 Range: 40-59 cm; 15.75-23.23 in.
 V = 5.08(.06)% N = 4060

Percentile Values

%	CM	IN.
1	83.5	32.9
2	84.6	33.3
3	85.1	33.5
5	85.8	33.8
10	87.2	34.3
15	87.9	34.6
20	88.6	34.9
25	89.1	35.1
30	89.6	35.3
35	90.1	35.5
40	90.5	35.6
45	90.9	35.8
50	91.4	36.0
55	91.8	36.1
60	92.2	36.3
65	92.6	36.5
70	93.1	36.6
75	93.6	36.8
80	94.1	37.0
85	94.7	37.3
90	95.5	37.6
95	96.6	38.0
97	97.4	38.3
98	98.0	38.6
99	98.9	38.9



SITTING HEIGHT

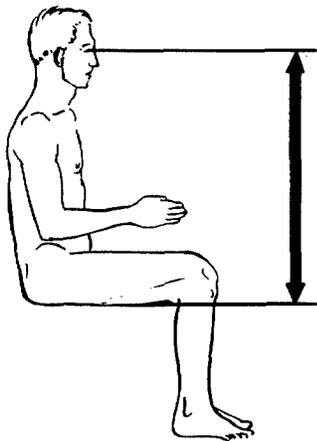
Subject sits erect, looking directly forward (head oriented in the Frankfort plane), and his feet resting on a surface so that his knees are bent at about right angles. With the anthropometer arm firmly touching the scalp, measure vertically from the sitting surface to the top of the head.

Mean: 91.28(.05) cm; 35.94(.02) in.

Standard Deviation: 3.27(.04) cm; 1.29(.02) in.

Range: 76-102 cm; 29.92-40.16 in.

V = 3.58(.04)% N = 4061



Percentile Values

%	CM	IN.
1	72.4	28.5
2	73.3	28.9
3	73.8	29.1
5	74.7	29.4
10	76.0	29.9
15	76.7	30.2
20	77.3	30.4
25	77.8	30.6
30	78.3	30.8
35	78.8	31.0
40	79.2	31.2
45	79.6	31.4
50	80.0	31.5
55	80.4	31.7
60	80.8	31.8
65	81.3	32.0
70	81.7	32.2
75	82.2	32.3
80	82.7	32.6
85	83.3	32.8
90	84.1	33.1
95	85.2	33.5
97	85.9	33.8
98	86.4	34.0
99	87.3	34.4

EYE HEIGHT, SITTING

(INTERNAL CANTHUS HEIGHT, SITTING)

Subject sits erect, looking directly forward (head oriented in the Frankfort plane), his feet resting on a surface so that the knees are bent at about right angles. Using the anthropometer, measure the vertical distance from the sitting surface to the inner corner of the eye.

Mean: 79.94(.05) cm; 31.47(.02) in.

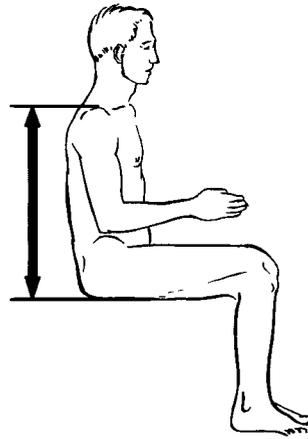
Standard Deviation: 3.22(.04) cm; 1.27(.02) in.

Range: 67-93 cm; 26.38-36.61 in.

V = 4.03(.04)% N = 4061

Percentile Values

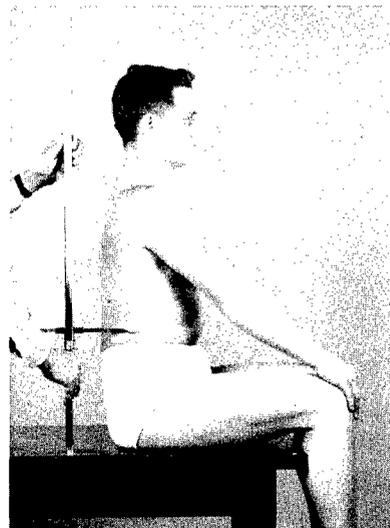
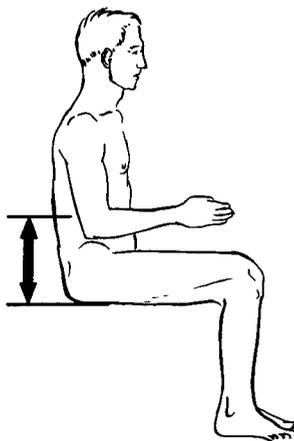
%	CM	IN.
1	52.2	20.6
2	53.0	20.9
3	53.5	21.1
5	54.2	21.3
10	55.3	21.8
15	56.1	22.1
20	56.7	22.3
25	57.2	22.5
30	57.6	22.7
35	58.0	22.8
40	58.4	23.0
45	58.8	23.1
50	59.2	23.3
55	59.5	23.4
60	59.9	23.6
65	60.3	23.7
70	60.6	23.9
75	61.0	24.0
80	61.5	24.2
85	62.0	24.4
90	62.8	24.7
95	63.8	25.1
97	64.4	25.4
98	64.9	25.6
99	65.6	25.8



**SHOULDER HEIGHT, SITTING
(ACROMIAL HEIGHT, SITTING)**

Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles. Using the anthropometer, measure the vertical distance from the sitting surface to right acromion as marked.

Mean: 59.07(.05) cm; 23.26(.02) in.
 Standard Deviation: 2.89(.04) cm; 1.14(.02) in.
 Range: 48-69 cm; 18.90-27.17 in.
 V = 4.89(.05)% N = 4057



Percentile Values

%	CM	IN.
1	18.8	7.4
2	19.4	7.6
3	19.7	7.8
5	20.1	7.9
10	21.0	8.3
15	21.4	8.4
20	21.9	8.6
25	22.2	8.7
30	22.5	8.9
35	22.8	9.0
40	23.1	9.1
45	23.3	9.2
50	23.6	9.3
55	23.8	9.4
60	24.1	9.5
65	24.3	9.6
70	24.6	9.7
75	24.8	9.8
80	25.2	9.9
85	25.5	10.1
90	25.9	10.2
95	26.5	10.4
97	26.8	10.6
98	27.1	10.7
99	27.6	10.9

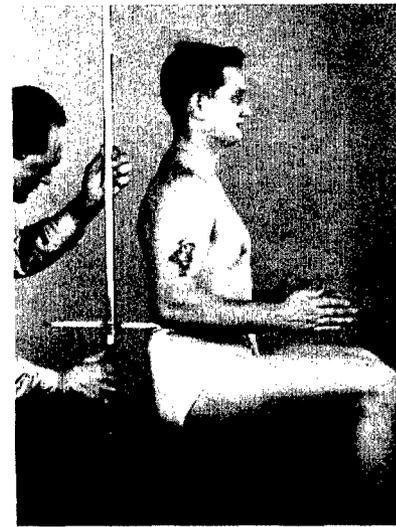
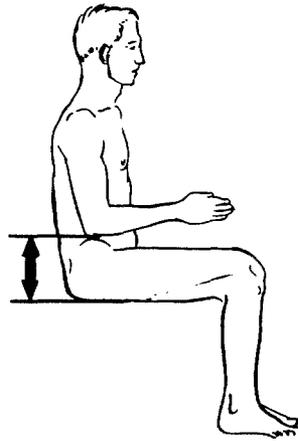
WAIST HEIGHT, SITTING

Subject sits erect, his feet resting on a surface so that his knees are bent at about right angles. Using the anthropometer, measure the vertical distance from the sitting surface to the waist point marked on the right side.

Mean: 23.46(.03) cm; 9.24(.01) in.
 Standard Deviation: 1.94(.02) cm; .76(.01) in.
 Range: 16-33 cm; 6.30-12.99 in.
 V = 8.27(.09)% N = 4062

Percentile Values

%	CM	IN.
1	16.7	6.6
2	17.7	7.0
3	18.2	7.2
5	18.9	7.4
10	19.9	7.8
15	20.5	8.1
20	21.0	8.3
25	21.4	8.4
30	21.9	8.6
35	22.2	8.7
40	22.5	8.9
45	22.9	9.0
50	23.2	9.1
55	23.6	9.3
60	23.9	9.4
65	24.3	9.6
70	24.6	9.7
75	25.0	9.8
80	25.4	10.0
85	25.9	10.2
90	26.6	10.5
95	27.4	10.8
97	27.9	11.0
98	28.4	11.2
99	29.1	11.5



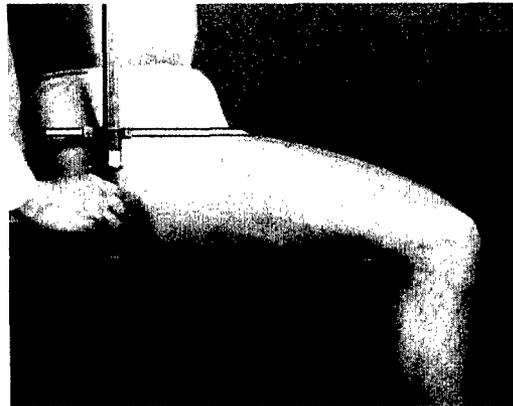
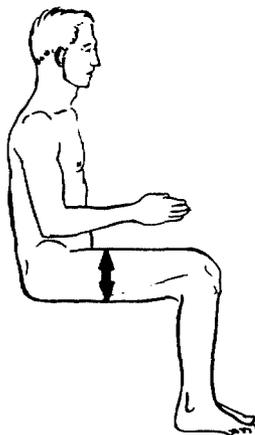
ELBOW REST HEIGHT (SITTING)

Subject sits erect, his feet resting on a surface so that his knees are bent at about right angles, his right upper arm hanging at his side and his forearm extended horizontally. Using the anthropometer, measure the vertical distance from the sitting surface to the bottom of the right elbow.

Mean: 23.16(.04) cm; 9.12(.02) in.
 Standard Deviation: 2.63(.03) cm; 1.04(.01) in.
 Range: 11-33 cm; 4.33-12.99 in.
 V = 11.36(.13)% N = 4063

Percentile Values

%	CM	IN.
1	11.4	4.5
2	11.7	4.6
3	11.9	4.7
5	12.2	4.8
10	12.6	5.0
15	12.9	5.1
20	13.2	5.2
25	13.4	5.3
30	13.6	5.3
35	13.7	5.4
40	13.9	5.5
45	14.0	5.5
50	14.2	5.6
55	14.3	5.6
60	14.5	5.7
65	14.6	5.8
70	14.8	5.8
75	15.2	6.0
80	15.4	6.1
85	15.6	6.2
90	15.9	6.3
95	16.4	6.5
97	16.7	6.6
98	16.9	6.7
99	17.2	6.8



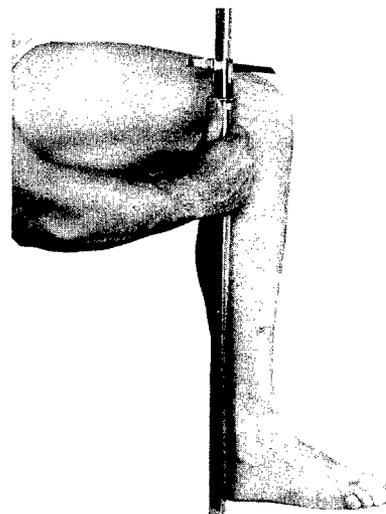
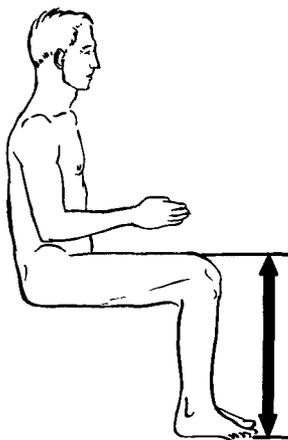
THIGH CLEARANCE HEIGHT, SITTING

Subject sits erect, his thighs entirely supported by the sitting surface and his lower legs hanging free just beyond the edge of the table. Using the anthropometer, measure the vertical distance from the sitting surface to the top of the right thigh at its intersection with the abdomen.

Mean: 14.25(.02) cm; 5.61(.01) in.
 Standard Deviation: 1.33(.01) cm; .52(.00) in.
 Range: 10-18 cm; 3.94-7.09 in.
 V = 9.33(.10)% N = 4061

Percentile Values

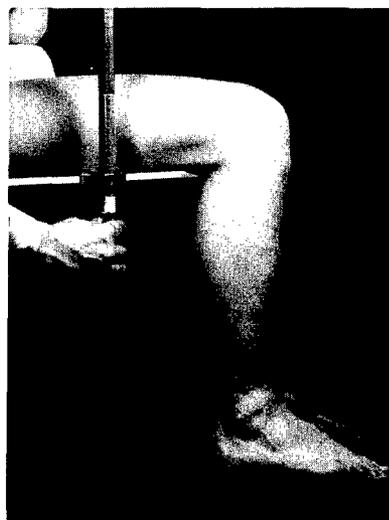
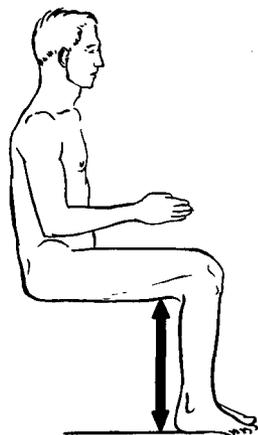
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	49.5	19.5
2	50.1	19.7
3	50.5	19.9
5	51.0	20.1
10	51.9	20.4
15	52.5	20.6
20	53.0	20.8
25	53.3	21.0
30	53.7	21.2
35	54.1	21.3
40	54.4	21.4
45	54.7	21.6
50	55.1	21.7
55	55.4	21.8
60	55.7	21.9
65	56.1	22.1
70	56.4	22.2
75	56.8	22.4
80	57.2	22.5
85	57.7	22.7
90	58.3	23.0
95	59.1	23.3
97	59.8	23.5
98	60.3	23.7
99	61.0	24.0



KNEE HEIGHT, SITTING

Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles. Using the anthropometer, measure the vertical distance from the footrest surface to the top of the right knee (not to the kneecap).

Mean: 55.04(.04) cm; 21.67(.02) in.
 Standard Deviation: 2.51(.03) cm; .99(.01) in.
 Range: 44-63 cm; 17.32-24.80 in.
 V = 4.56(.05)% N = 4060



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	38.8	15.3
2	39.3	15.5
3	39.6	15.6
5	40.0	15.7
10	40.6	16.0
15	41.1	16.2
20	41.5	16.3
25	41.8	16.5
30	42.1	16.6
35	42.4	16.7
40	42.6	16.8
45	42.9	16.9
50	43.1	17.0
55	43.4	17.1
60	43.6	17.2
65	43.9	17.3
70	44.2	17.4
75	44.5	17.5
80	44.8	17.6
85	45.2	17.8
90	45.7	18.0
95	46.3	18.2
97	46.8	18.4
98	47.2	18.6
99	47.8	18.8

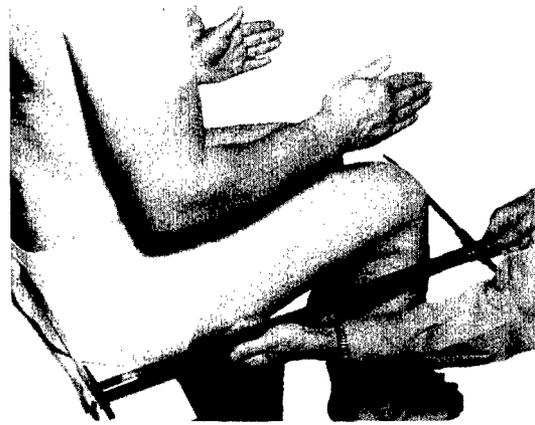
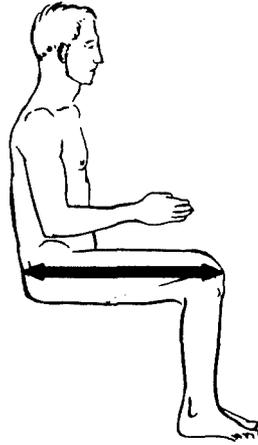
POPLITEAL HEIGHT, SITTING

Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles. Using the anthropometer, measure the vertical distance from the footrest surface to the underside of the right knee (popliteal area).

Mean: 43.10(.03) cm; 16.97(.01) in.
 Standard Deviation: 1.96(.02) cm; .77(.01) in.
 Range: 36-49 cm; 14.17-19.29 in.
 V = 4.55(.05)% N = 4059

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	53.9	21.2
2	54.6	21.5
3	55.1	21.7
5	55.7	21.9
10	56.6	22.3
15	57.2	22.6
20	57.7	22.8
25	58.2	22.9
30	58.6	23.1
35	59.0	23.2
40	59.3	23.4
45	59.7	23.5
50	60.0	23.6
55	60.3	23.8
60	60.7	23.9
65	61.0	24.0
70	61.4	24.2
75	61.8	24.3
80	62.2	24.5
85	62.8	24.7
90	63.4	25.0
95	64.5	25.4
97	65.2	25.7
98	65.7	25.9
99	66.5	26.2



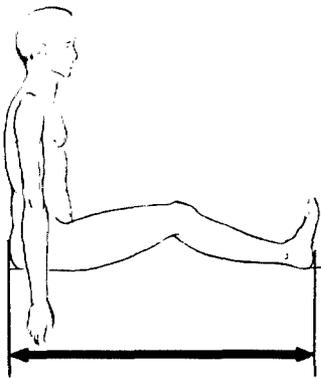
BUTTOCK-KNEE LENGTH

Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles. Using the anthropometer, measure the horizontal distance from the rearmost point of the right buttock to the front of the kneecap.

Mean: 60.00(.04) cm; 23.62(.02) in.
 Standard Deviation: 2.70(.03) cm; 1.06(.01) in.
 Range: 47-70 cm; 18.50-27.56 in.
 V = 4.50(.05)% N = 4060

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	97.1	38.2
2	98.3	38.7
3	99.1	39.0
5	100.1	39.4
10	101.9	40.1
15	103.1	40.6
20	104.1	41.0
25	105.0	41.3
30	105.7	41.6
35	106.4	41.9
40	107.1	42.2
45	107.7	42.4
50	108.4	42.7
55	109.0	42.9
60	109.7	43.2
65	110.4	43.5
70	111.1	43.7
75	111.9	44.1
80	112.7	44.4
85	113.8	44.8
90	115.1	45.3
95	117.1	46.1
97	118.3	46.6
98	119.3	47.0
99	121.2	47.7



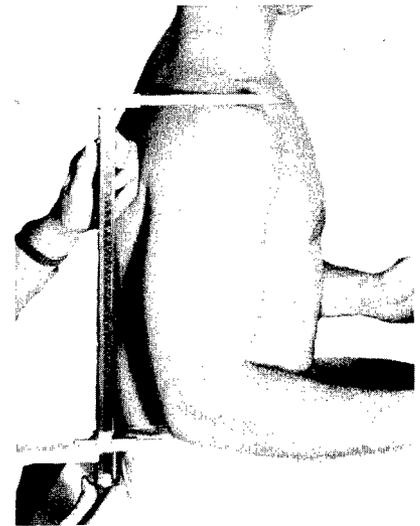
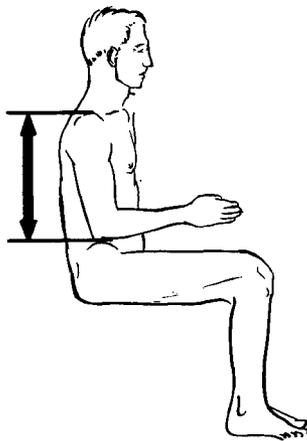
BUTTOCK-LEG LENGTH

Subject sits erect with his buttocks against the wall and his right leg extended as far as possible on the table. Touch the block against the base of the heel, and record the distance from the wall as indicated on the scale laid off on the table top. (See note on page 9.)

Mean: 108.45(.08) cm; 42.70(.03) in.
 Standard Deviation: 5.18(.06) cm; 2.04(.02) in.
 Range: 90-127 cm; 35.43-50.00 in.
 V = 4.78(.05)% N = 4060

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	32.4	12.8
2	32.9	13.0
3	33.2	13.1
5	33.6	13.2
10	34.1	13.4
15	34.5	13.6
20	35.0	13.8
25	35.2	13.9
30	35.5	14.0
35	35.7	14.1
40	36.0	14.2
45	36.2	14.3
50	36.4	14.3
55	36.6	14.4
60	36.9	14.5
65	37.1	14.6
70	37.4	14.7
75	37.6	14.8
80	37.9	14.9
85	38.3	15.1
90	38.7	15.2
95	39.2	15.4
97	39.6	15.6
98	39.8	15.7
99	40.3	15.9



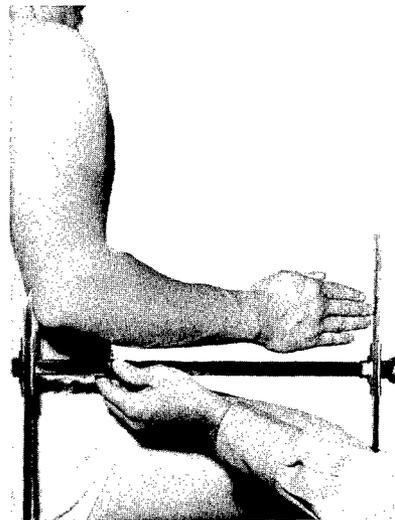
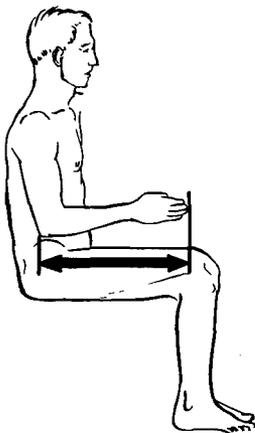
SHOULDER-ELBOW LENGTH

Subject sits erect, his right upper arm hanging at his side and his forearm extended horizontally. Using the anthropometer, measure the vertical distance from right acromion as marked to the bottom of the elbow.

Mean: 36.37(.03) cm; 14.32(.01) in.
 Standard Deviation: 1.75(.02) cm; .69(.01) in.
 Range: 29-46 cm; 11.42-18.11 in.
 V = 4.81(.05)% N = 4059

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	43.2	17.0
2	43.7	17.2
3	44.1	17.4
5	44.6	17.6
10	45.3	17.8
15	45.8	18.0
20	46.2	18.2
25	46.6	18.3
30	46.9	18.5
35	47.2	18.6
40	47.4	18.7
45	47.7	18.8
50	48.0	18.9
55	48.2	19.0
60	48.5	19.1
65	48.8	19.2
70	49.0	19.3
75	49.4	19.4
80	49.7	19.6
85	50.1	19.7
90	50.6	19.9
95	51.2	20.2
97	51.8	20.4
98	52.1	20.5
99	52.6	20.7



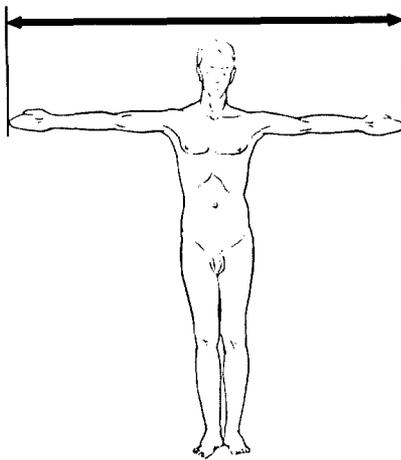
FOREARM-HAND LENGTH

Subject sits erect, his right upper arm hanging at his side, his forearm and hand extended horizontally. Using the anthropometer, measure the distance from the tip of the right elbow to the tip of the longest finger.

Mean: 47.91(.03) cm; 18.86(.01) in.
 Standard Deviation: 2.07(.02) cm; .81(.01) in.
 Range: 39-56 cm; 15.35-22.05 in.
 V = 4.41(.05)% N = 4059

Percentile Values

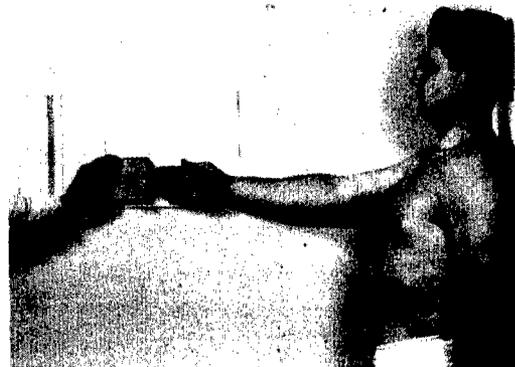
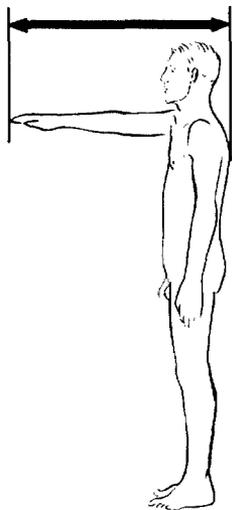
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	162.3	63.9
2	164.4	64.7
3	165.7	65.2
5	167.5	65.9
10	170.3	67.0
15	172.2	67.8
20	173.7	68.4
25	174.9	68.9
30	176.0	69.3
35	177.1	69.7
40	178.1	70.1
45	179.0	70.5
50	179.9	70.8
55	180.8	71.2
60	181.8	71.6
65	182.7	71.9
70	183.8	72.3
75	184.8	72.8
80	186.2	73.3
85	187.6	73.9
90	189.3	74.5
95	192.0	75.6
97	193.9	76.3
98	195.2	76.9
99	197.2	77.6



SPAN

Subject stands erect, his back to the rear wall, his arms extended laterally to their maximum, the longest finger of one hand just touching a side wall (or an arbitrarily placed block). Using the scale on the rear wall, measure the distance from the side wall to the tip of the longest finger of the other hand.

Mean: 179.83(.12) cm; 70.80(.05) in.
 Standard Deviation: 7.46(.09) cm; 2.94(.04) in.
 Range: 148-209 cm; 58.27-82.28 in.
 V = 4.15(.05)% N = 4058



ARM REACH FROM WALL

Subject stands erect in a corner of the room, his shoulders pressed against the rear wall, his right arm and hand extended horizontally along the side wall. Using the scale on the side wall, measure the distance from the rear wall to the tip of the longest finger.

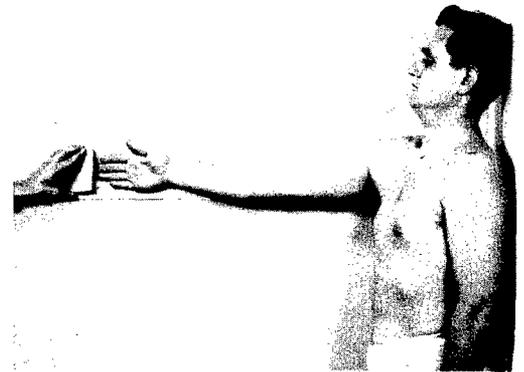
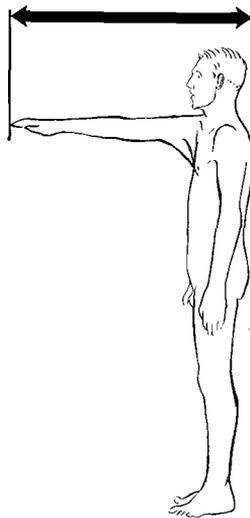
Mean: 87.86(.07) cm; 34.59(.03) in.
 Standard Deviation: 4.18(.05) cm; 1.65(.02) in.
 Range: 70-101 cm; 27.56-39.76 in.
 V = 4.76(.05)% N = 4062

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	78.4	30.9
2	79.5	31.3
3	80.1	31.5
5	81.0	31.9
10	82.6	32.5
15	83.5	32.9
20	84.4	33.2
25	85.1	33.5
30	85.7	33.7
35	86.3	34.0
40	86.9	34.2
45	87.4	34.4
50	87.9	34.6
55	88.4	34.8
60	88.9	35.0
65	89.5	35.2
70	90.1	35.5
75	90.7	35.7
80	91.4	36.0
85	92.2	36.3
90	93.3	36.7
95	94.8	37.3
97	95.8	37.7
98	96.6	38.0
99	98.0	38.6

Percentile Values

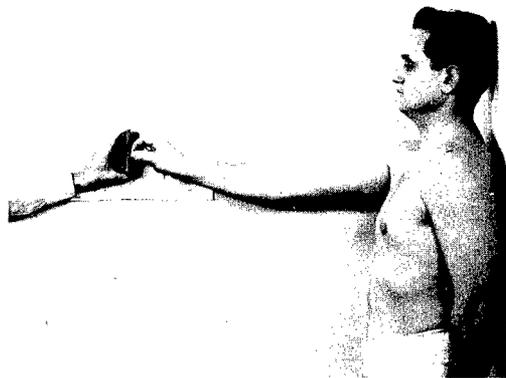
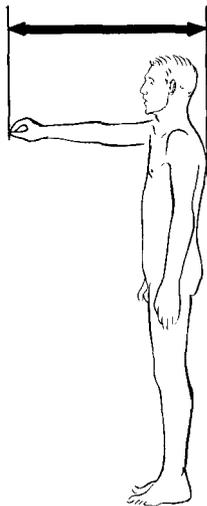
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	86.7	34.1
2	88.0	34.6
3	88.9	35.0
5	90.0	35.4
10	92.1	36.2
15	93.1	36.7
20	94.1	37.1
25	94.8	37.3
30	95.6	37.6
35	96.2	37.9
40	96.9	38.1
45	97.5	38.4
50	98.1	38.6
55	98.7	38.9
60	99.3	39.1
65	100.0	39.4
70	100.6	39.6
75	101.3	39.9
80	102.0	40.2
85	102.9	40.5
90	104.1	41.0
95	105.9	41.7
97	107.3	42.2
98	108.3	42.6
99	109.8	43.2



MAXIMUM REACH FROM WALL

Subject stands erect in a corner of the room, his back pressed against the rear wall and his right shoulder thrust as far forward as possible, his right arm and hand extended horizontally along the side wall. Using the scale on the side wall, measure the distance from the rear wall to the tip of the longest finger.

Mean: 98.03(.08) cm; 38.59(.03) in.
 Standard Deviation: 4.82(.06); 1.90(.02) in.
 Range: 79-117 cm; 31.10-46.06 in.
 V = 4.92(.05)% N = 4055



FUNCTIONAL REACH

Subject stands erect in a corner of the room, his shoulders pressed against the rear wall, his right arm and hand extended horizontally along the side wall, except that the tips of his thumb and forefinger are pressed together. Using the scale on the side wall, measure the distance from the rear wall to the tip of the thumb.

Mean: 82.12(.07) cm; 32.33(.03) in.
 Standard Deviation: 4.14(.05) cm; 1.63(.02) in.
 Range: 68-103 cm; 26.77-40.55 in.
 V = 5.04(.06)% N = 4053

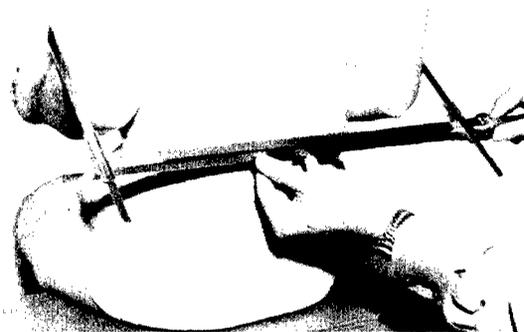
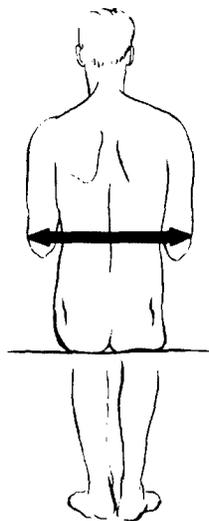
Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	73.1	28.8
2	74.0	29.1
3	74.6	29.4
5	75.5	29.7
10	76.9	30.3
15	77.9	30.7
20	78.7	31.0
25	79.4	31.3
30	80.0	31.5
35	80.5	31.7
40	81.0	31.9
45	81.6	32.1
50	82.1	32.3
55	82.6	32.5
60	83.1	32.7
65	83.7	32.9
70	84.3	33.2
75	84.9	33.4
80	85.6	33.7
85	86.4	34.0
90	87.4	34.4
95	88.9	35.0
97	90.3	35.6
98	91.2	35.9
99	92.5	36.4

BODY BREADTHS AND THICKNESSES

Percentile Values

%	CM	IN.
1	36.9	14.5
2	37.6	14.8
3	38.0	15.0
5	38.5	15.2
10	39.5	15.5
15	40.3	15.8
20	40.9	16.1
25	41.4	16.3
30	41.9	16.5
35	42.3	16.7
40	42.8	16.8
45	43.2	17.0
50	43.7	17.2
55	44.1	17.4
60	44.6	17.6
65	45.1	17.7
70	45.7	18.0
75	46.3	18.2
80	46.9	18.5
85	47.7	18.8
90	48.7	19.2
95	50.3	19.8
97	51.3	20.2
98	52.0	20.5
99	53.2	20.9



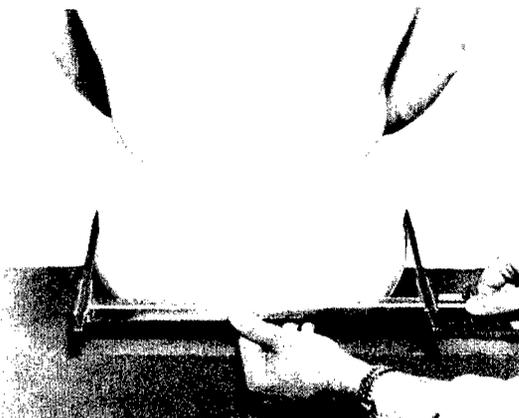
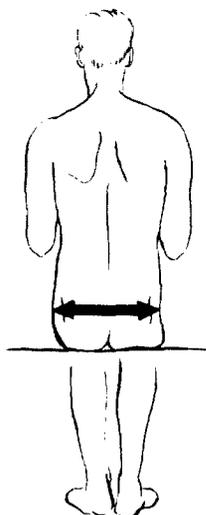
ELBOW-TO-ELBOW BREADTH

Subject sits erect, his upper arms hanging at his side, his forearms extended horizontally, and his elbows resting lightly against his body. Using the anthropometer, measure the maximum horizontal distance across the lateral surfaces of the elbows.

Mean: 43.89(.06) cm; 17.28(.02) in.
 Standard Deviation: 3.61(.04) cm; 1.42(.02) in.
 Range: 29-60 cm; 11.42-23.62 in.
 V = 8.23(.09)% N = 4060

Percentile Values

%	CM	IN.
1	31.0	12.2
2	31.4	12.4
3	31.8	12.5
5	32.2	12.7
10	32.8	12.9
15	33.3	13.1
20	33.6	13.2
25	34.0	13.4
30	34.3	13.5
35	34.6	13.6
40	34.9	13.7
45	35.1	13.8
50	35.4	13.9
55	35.7	14.0
60	36.0	14.2
65	36.3	14.3
70	36.6	14.4
75	37.0	14.6
80	37.4	14.7
85	37.8	14.9
90	38.5	15.1
95	39.2	15.4
97	40.0	15.7
98	40.4	15.9
99	41.2	16.2



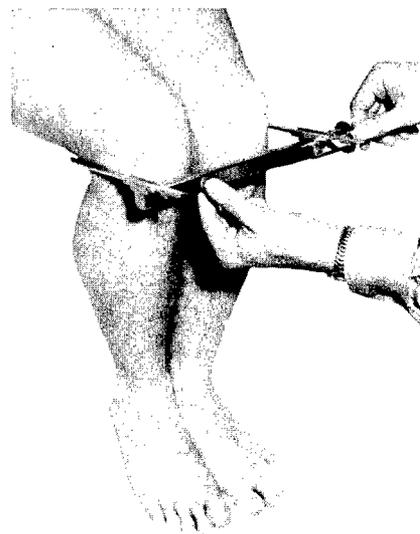
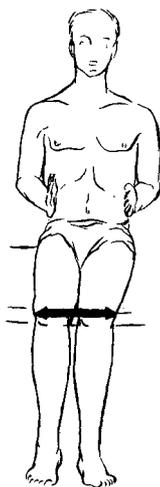
HIP BREADTH, SITTING

Subject sits erect. Using the anthropometer, measure horizontally across the widest portion of the hips.

Mean: 35.49(.03) cm; 13.97(.01) in.
 Standard Deviation: 2.21(.02) cm; .87(.01) in.
 Range: 29-46 cm; 11.42-18.11 in.
 V = 6.23(.07)% N = 4058

Percentile Values

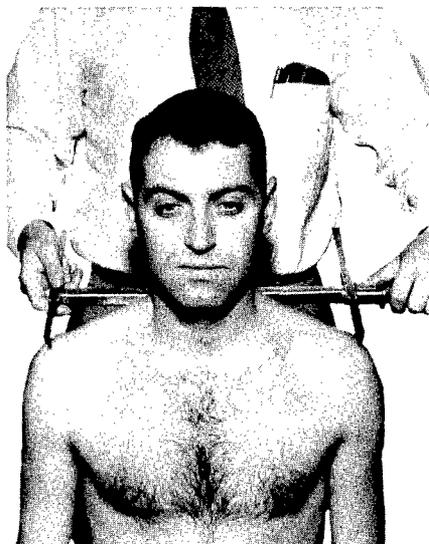
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	17.7	7.0
2	18.0	7.1
3	18.1	7.1
5	18.3	7.2
10	18.5	7.3
15	18.9	7.4
20	19.1	7.5
25	19.3	7.6
30	19.4	7.6
35	19.6	7.7
40	19.7	7.8
45	19.9	7.8
50	20.1	7.9
55	20.2	8.0
60	20.4	8.0
65	20.6	8.1
70	20.8	8.2
75	20.9	8.2
80	21.2	8.4
85	21.6	8.5
90	21.9	8.6
95	22.4	8.8
97	23.0	9.1
98	23.4	9.2
99	24.0	9.4



KNEE-TO-KNEE BREADTH

Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles, and the knees touching lightly. Using the anthropometer, measure the maximum horizontal distance across the lateral surfaces of the knees.

Mean: 20.14(.02) cm; 7.93(.01) in.
 Standard Deviation: 1.32(.01) cm; .52(.00) in.
 Range: 16-26 cm; 6.30-10.24 in.
 V = 6.55(.07)% N = 4056



BIACROMIAL DIAMETER

Subject sits erect, his upper arms hanging at his sides and his forearms extended horizontally. Using the anthropometer, measure between the points marked at the ends of the shoulders (acromion to acromion).

Mean: 40.01(.03) cm; 15.75(.01) in.
 Standard Deviation: 1.88(.02) cm; .74(.01) in.
 Range: 32-47 cm; 12.60-18.50 in.
 V = 4.72(.05)% N = 4063

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	35.5	14.0
2	36.1	14.2
3	36.5	14.4
5	37.0	14.6
10	37.6	14.8
15	38.1	15.0
20	38.5	15.1
25	38.8	15.3
30	39.1	15.4
35	39.3	15.5
40	39.6	15.6
45	39.9	15.7
50	40.1	15.8
55	40.3	15.9
60	40.6	16.0
65	40.8	16.1
70	41.1	16.2
75	41.4	16.3
80	41.7	16.4
85	42.0	16.5
90	42.5	16.7
95	43.0	16.9
97	43.4	17.1
98	43.7	17.2
99	44.3	17.4

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	40.5	15.9
2	41.0	16.1
3	41.4	16.3
5	41.9	16.5
10	42.6	16.8
15	43.1	17.0
20	43.5	17.1
25	43.9	17.3
30	44.2	17.4
35	44.5	17.5
40	44.8	17.6
45	45.1	17.7
50	45.4	17.9
55	45.7	18.0
60	46.0	18.1
65	46.3	18.2
70	46.7	18.4
75	47.0	18.5
80	47.4	18.7
85	47.8	18.8
90	48.5	19.1
95	49.3	19.4
97	50.0	19.7
98	50.4	19.8
99	51.1	20.1



SHOULDER BREADTH (BIDELTOID DIAMETER)

Subject sits erect, his upper arms hanging at his sides, and his forearms extended horizontally. Using the anthropometer, measure the horizontal distance across the maximum lateral protrusion of the deltoid muscles.

Mean: 45.41(.04) cm; 17.88(.02) in.
 Standard Deviation: 2.30(.03) cm; .91(.01) in.
 Range: 37-58 cm; 14.57-22.83 in.
 V = 5.06(.06)% N = 4057



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	26.4	10.4
2	26.8	10.6
3	27.1	10.7
5	27.5	10.8
10	28.1	11.1
15	28.5	11.2
20	28.9	11.4
25	29.2	11.5
30	29.5	11.6
35	29.7	11.7
40	30.0	11.8
45	30.2	11.9
50	30.5	12.0
55	30.7	12.1
60	31.0	12.2
65	31.3	12.3
70	31.6	12.4
75	31.9	12.5
80	32.2	12.7
85	32.7	12.9
90	33.3	13.1
95	34.1	13.4
97	34.8	13.7
98	35.2	13.9
99	35.8	14.1

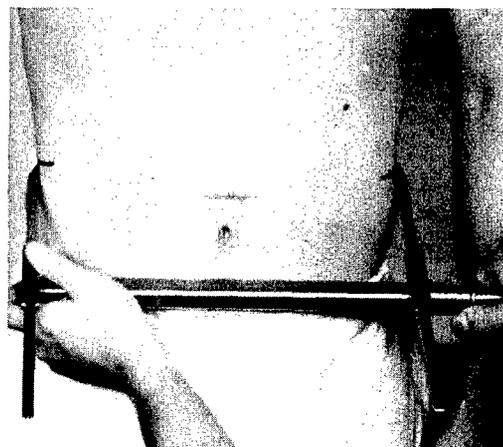
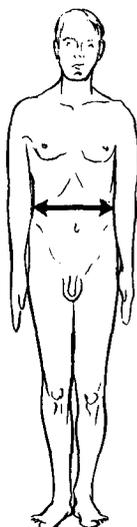
CHEST BREADTH

Subject stands erect with his arms initially raised and then lowered after the instrument is in place. Holding the anthropometer at the level of the nipples, measure the breadth across the chest during normal breathing.

Mean: 30.56(.03) cm; 12.03(.01) in.
 Standard Deviation: 2.04(.02) cm; .80(.01) in.
 Range: 24-39 cm; 9.45-15.35 in.
 V = 6.68(.07)% N = 4058

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	22.7	8.9
2	23.1	9.1
3	23.4	9.2
5	23.8	9.4
10	24.3	9.6
15	24.7	9.7
20	25.1	9.9
25	25.4	10.0
30	25.7	10.1
35	26.0	10.2
40	26.3	10.4
45	26.6	10.5
50	26.9	10.6
55	27.1	10.7
60	27.5	10.8
65	27.8	10.9
70	28.1	11.1
75	28.6	11.2
80	29.0	11.4
85	29.6	11.6
90	30.3	11.9
95	31.2	12.3
97	32.0	12.6
98	32.7	12.9
99	33.8	13.3



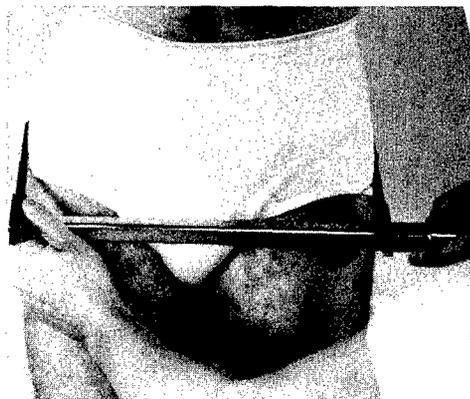
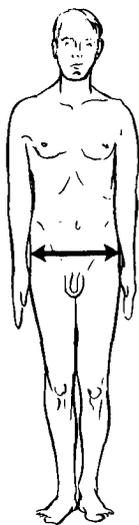
WAIST BREADTH

Subject stands erect with the abdomen relaxed. Using the anthropometer, measure between the waist points marked on the subject's left and right sides.

Mean: 27.07(.04) cm; 10.66(.02) in.
 Standard Deviation: 2.40(.03) cm; .94(.01) in.
 Range: 20-39 cm; 7.87-15.35 in.
 V = 8.87(.10)% N = 4063

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	28.7	11.3
2	29.6	11.7
3	30.1	11.9
5	30.7	12.1
10	31.3	12.3
15	31.7	12.5
20	32.0	12.6
25	32.3	12.7
30	32.5	12.8
35	32.8	12.9
40	33.0	13.0
45	33.2	13.1
50	33.4	13.2
55	33.7	13.3
60	33.9	13.3
65	34.1	13.4
70	34.4	13.6
75	34.7	13.7
80	35.0	13.8
85	35.5	14.0
90	35.9	14.1
95	36.7	14.4
97	37.3	14.7
98	37.7	14.8
99	38.5	15.2



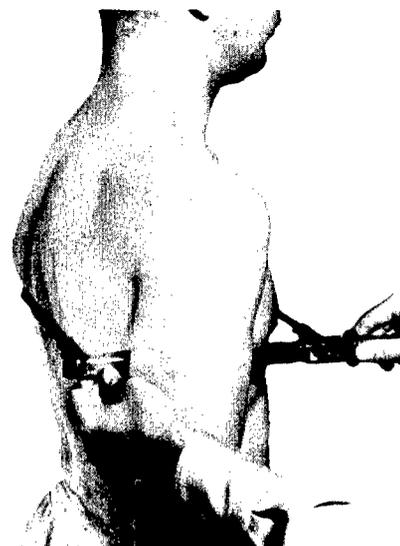
HIP BREADTH

Subject stands erect. Using the anthropometer, measure horizontally across the widest portion of the hips.

Mean: 33.45(.03) cm; 13.17(.01) in.
 Standard Deviation: 1.85(.02) cm; .73(.01) in.
 Range: 21-40 cm; 8.27-15.75 in.
 V = 5.53(.06)% N = 4062

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	19.3	7.6
2	19.6	7.7
3	19.9	7.8
5	20.2	8.0
10	20.7	8.2
15	21.2	8.3
20	21.4	8.4
25	21.7	8.6
30	22.0	8.7
35	22.2	8.8
40	22.5	8.8
45	22.7	8.9
50	22.9	9.0
55	23.2	9.1
60	23.4	9.2
65	23.7	9.3
70	23.9	9.4
75	24.3	9.6
80	24.7	9.7
85	25.0	9.9
90	25.6	10.1
95	26.4	10.4
97	27.0	10.6
98	27.4	10.8
99	28.1	11.1



CHEST DEPTH

Subject stands erect with his arms initially raised and then lowered after the instrument is in place. Holding the anthropometer horizontally on the subject's right side, at the level of the nipples, measure the depth of the chest during normal breathing.

Mean: 23.01(.03) cm; 9.06(.01) in.
 Standard Deviation: 1.91(.02) cm; .75(.01) in.
 Range: 17-33 cm; 6.69-12.99 in.
 V = 8.30(.09)% N = 4063



WAIST DEPTH

Subject stands erect with his abdomen relaxed and with his arms initially raised and then lowered after the instrument is in place. Holding the anthropometer horizontally on the subject's right side, measure between the points marked on the front and the back of the waist.

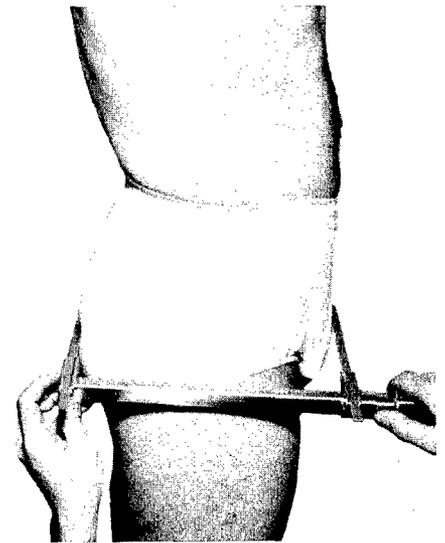
Mean: 20.18(.03) cm; 7.94(.01) in.
 Standard Deviation: 2.22(.02) cm; .88(.01) in.
 Range: 14-30 cm; 5.51-11.81 in.
 V = 11.05(.12)% N = 4062

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	16.1	6.3
2	16.5	6.5
3	16.8	6.6
5	17.1	6.7
10	17.6	6.9
15	18.0	7.1
20	18.3	7.2
25	18.6	7.3
30	18.9	7.4
35	19.2	7.5
40	19.4	7.4
45	19.7	7.8
50	20.0	7.9
55	20.3	8.0
60	20.6	8.1
65	20.9	8.2
70	21.2	8.4
75	21.6	8.5
80	22.0	8.7
85	22.6	8.9
90	23.2	9.1
95	24.2	9.5
97	24.9	9.8
98	25.4	10.0
99	26.1	10.3

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	18.2	7.2
2	18.6	7.3
3	18.9	7.4
5	19.2	7.6
10	19.8	7.8
15	20.2	8.0
20	20.6	8.1
25	20.9	8.2
30	21.2	8.4
35	21.5	8.5
40	21.8	8.6
45	22.1	8.7
50	22.3	8.8
55	22.6	8.9
60	22.9	9.0
65	23.1	9.1
70	23.5	9.2
75	23.8	9.4
80	24.2	9.5
85	24.7	9.7
90	25.2	9.9
95	26.0	10.2
97	26.6	10.5
98	26.9	10.6
99	27.6	10.9



BUTTOCK DEPTH

Subject stands erect. Holding the anthropometer horizontally on the subject's right side, measure the depth of the body at the level of the maximum protrusion of the buttocks.

Mean: 22.37(.03) cm; 8.81(.01) in.
 Standard Deviation: 2.09(.02) cm; .82(.01) in.
 Range: 16-30 cm; 6.30-11.81 in.
 V = 9.34(.10)% N = 4058

CIRCUMFERENCES AND BODY SURFACE DIMENSIONS



NECK CIRCUMFERENCE

Subject stands erect. Holding the tape in a plane perpendicular to the axis of the neck and passing it just below the 'Adam's Apple', measure the circumference of the neck.

Mean: 38.00(.03) cm; 14.96(.01) in.
 Standard Deviation: 1.89(.02) cm; .74(.01) in.
 Range: 26-49 cm; 10.24-19.29 in.
 V = 4.97(.06)%c N = 4041

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	34.0	13.3
2	34.4	13.5
3	34.7	13.7
5	35.1	13.8
10	35.7	14.1
15	36.1	14.2
20	36.5	14.4
25	36.8	14.5
30	37.0	14.6
35	37.3	14.7
40	37.5	14.8
45	37.7	14.8
50	37.9	14.9
55	38.2	15.0
60	38.4	15.1
65	38.7	15.2
70	38.9	15.3
75	39.2	15.4
80	39.5	15.5
85	39.9	15.7
90	40.4	15.9
95	41.1	16.2
97	41.7	16.4
98	42.1	16.6
99	42.7	16.8

Percentile Values

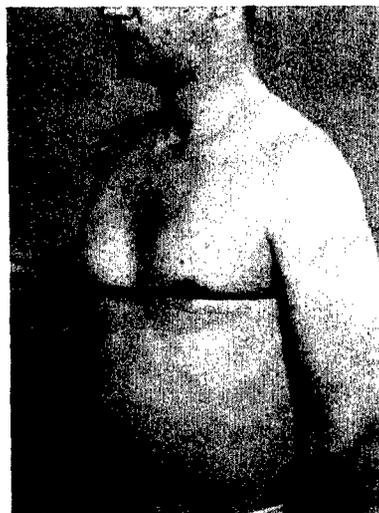
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	102.2	40.2
2	103.4	40.7
3	104.3	41.1
5	105.6	41.6
10	107.5	42.3
15	108.8	42.8
20	110.0	43.3
25	110.8	43.6
30	111.7	44.0
35	112.4	44.3
40	113.1	44.5
45	113.9	44.8
50	114.6	45.1
55	115.4	45.4
60	116.2	45.7
65	117.0	46.1
70	117.8	46.4
75	118.7	46.7
80	119.8	47.2
85	121.3	47.8
90	123.1	48.5
95	125.5	49.4
97	127.4	50.2
98	128.7	50.7
99	130.9	51.5



SHOULDER CIRCUMFERENCE

Subject stands erect. Holding the tape in a horizontal plane and passing it over the maximum lateral protrusions of the deltoid muscles, measure the circumference around the shoulders.

Mean: 114.94(.10) cm; 45.25(.04) in.
 Standard Deviation: 6.17(.07) cm; 2.43(.03) in.
 Range: 90-144 cm; 35.43-56.69 in.
 V = 5.37(.06)% N = 4053



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	85.7	33.7
2	87.0	34.3
3	87.9	34.6
5	89.1	35.1
10	91.1	35.9
15	92.2	36.3
20	93.3	36.8
25	94.2	37.1
30	95.0	37.4
35	95.8	37.7
40	96.7	38.1
45	97.5	38.4
50	98.2	38.7
55	99.0	39.0
60	99.7	39.3
65	100.6	39.6
70	101.5	40.0
75	102.5	40.3
80	103.7	40.8
85	105.2	41.4
90	106.9	42.1
95	109.7	43.2
97	111.1	43.7
98	112.2	44.1
99	113.9	44.8

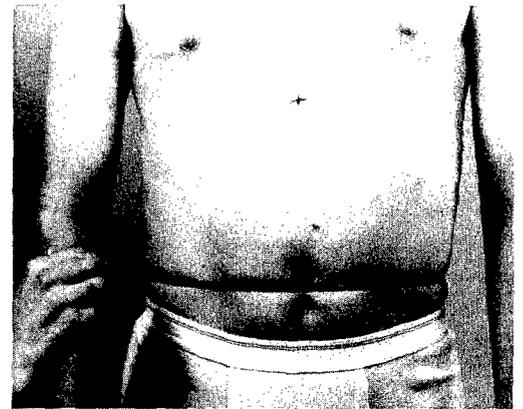
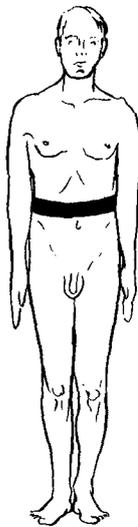
CHEST CIRCUMFERENCE

Subject stands erect, his arms initially raised then lowered after the tape is in place. Holding the tape in a horizontal plane at the level of the nipples, measure the maximum circumference of the chest during normal breathing.

Mean: 98.55(.10) cm; 38.80(.04) in.
 Standard Deviation: 6.22(.07) cm; 2.45(.03) in.
 Range: 79-126 cm; 31.10-49.61 in.
 V = 6.31(.07)% N = 4057

Percentile Values

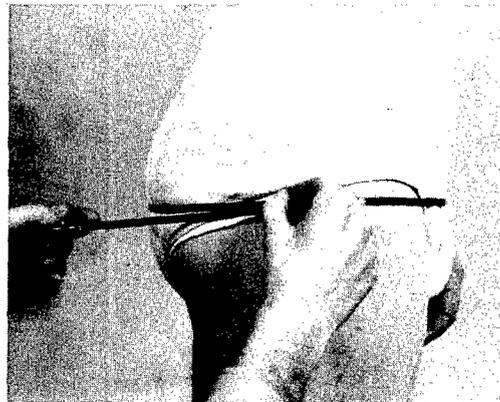
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	67.4	26.5
2	68.6	27.0
3	69.4	27.3
5	70.5	27.8
10	72.4	28.5
15	73.6	29.0
20	74.8	29.4
25	75.8	29.8
30	76.7	30.2
35	77.6	30.6
40	78.5	30.9
45	79.5	31.3
50	80.5	31.7
55	81.5	32.1
60	82.5	32.5
65	83.6	32.9
70	84.9	33.4
75	86.3	34.0
80	87.8	34.6
85	89.7	35.3
90	91.9	36.2
95	95.2	37.5
97	97.5	38.4
98	99.3	39.1
99	101.9	40.1



WAIST CIRCUMFERENCE

Subject stands erect with his abdomen relaxed. Holding the tape at the level of the marked points, measure the circumference around the waist.

Mean: 81.39(.12) cm; 32.04(.05) in.
 Standard Deviation: 7.68(.09) cm; 3.02(.04) in.
 Range: 62-120 cm; 24.41-47.24 in.
 V = 9.44(.11)% N = 4059



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	83.8	33.0
2	85.2	33.5
3	86.0	33.9
5	87.1	34.3
10	88.8	35.0
15	90.1	35.5
20	91.0	35.8
25	91.9	36.2
30	92.7	36.5
35	93.5	36.8
40	94.2	37.1
45	95.0	37.4
50	95.7	37.7
55	96.4	38.0
60	97.2	38.3
65	98.0	38.6
70	98.9	38.9
75	99.8	39.3
80	100.9	39.7
85	102.1	40.2
90	103.8	40.9
95	106.1	41.8
97	107.6	42.4
98	108.7	42.8
99	110.5	43.5

BUTTOCK CIRCUMFERENCE

Subject stands erect. Holding the tape in a horizontal plane at the level of the greatest rearward protrusion of the buttocks, measure the circumference around the hip region.

Mean: 95.97(.09) cm; 37.78(.04) in.
 Standard Deviation: 5.81(.06) cm; 2.29(.02) in.
 Range: 76-119 cm; 29.92-46.85 in.
 V = 6.05(.07)% N = 4049

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	46.6	18.3
2	48.2	19.0
3	48.9	19.3
5	49.7	19.6
10	51.2	20.2
15	52.2	20.6
20	53.1	20.9
25	53.9	21.2
30	54.6	21.5
35	55.2	21.7
40	55.8	22.0
45	56.3	22.2
50	56.8	22.4
55	57.4	22.6
60	57.9	22.8
65	58.6	23.1
70	59.2	23.3
75	59.9	23.6
80	60.7	23.9
85	61.6	24.2
90	62.6	24.7
95	64.2	25.3
97	65.2	25.7
98	66.0	26.0
99	67.1	26.4



THIGH CIRCUMFERENCE

Subject stands, his legs slightly apart. Holding the tape in a horizontal plane just below the lowest point in the gluteal furrow, measure the circumference of the right thigh.

Mean: 56.86(.07) cm; 22.39(.03) in.
 Standard Deviation: 4.41(.05) cm; 1.74(.02) in.
 Range: 37-73 cm; 14.57-28.74 in.
 V = 7.81(.09)% N = 4051



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	36.0	14.2
2	36.9	14.5
3	37.5	14.8
5	38.3	15.1
10	39.5	15.5
15	40.3	15.9
20	41.0	16.2
25	41.6	16.4
30	42.1	16.6
35	42.6	16.8
40	43.1	17.0
45	43.6	17.1
50	44.0	17.3
55	44.4	17.5
60	44.9	17.7
65	45.4	17.9
70	45.9	18.1
75	46.5	18.3
80	47.1	18.5
85	47.7	18.8
90	48.6	19.1
95	49.8	19.6
97	50.8	20.0
98	51.6	20.3
99	53.0	20.9

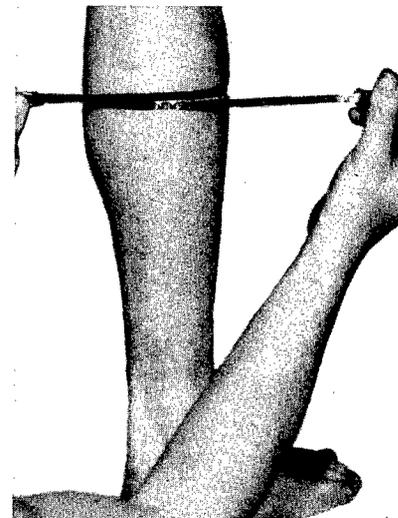
LOWER THIGH CIRCUMFERENCE

Subject stands. Holding the tape in a horizontal plane just above the right knee (over the medial vastus muscle but below any portion of the lateral vastus muscle), measure the circumference around the lower thigh.

Mean: 44.01(.06) cm; 17.33(.02) in.
 Standard Deviation: 3.57(.04) cm; 1.41(.02) in.
 Range: 30-59 cm; 11.81-23.23 in.
 V = 8.11(.09)% N = 4060

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	31.0	12.2
2	31.7	12.5
3	32.1	12.6
5	32.7	12.9
10	33.5	13.2
15	34.2	13.4
20	34.6	13.6
25	35.0	13.8
30	35.3	13.9
35	35.6	14.0
40	36.0	14.2
45	36.3	14.3
50	36.6	14.4
55	36.9	14.5
60	37.2	14.6
65	37.5	14.8
70	37.9	14.9
75	38.2	15.1
80	38.7	15.2
85	39.1	15.4
90	39.8	15.7
95	40.6	16.0
97	41.2	16.2
98	41.6	16.4
99	42.4	16.7



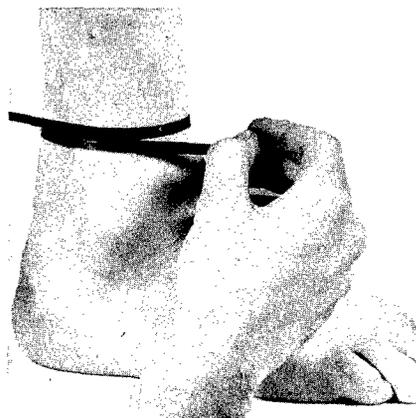
CALF CIRCUMFERENCE

Subject stands. Holding the tape in a horizontal plane, measure the maximum circumference of the right calf.

Mean: 36.57(.04) cm; 14.40(.02) in.
 Standard Deviation: 2.44(.03) cm; .96(.01) in.
 Range: 25-47 cm; 9.84-18.50 in.
 V = 6.67(.08)% N = 4048

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	19.8	7.8
2	20.1	7.9
3	20.3	8.0
5	20.5	8.1
10	21.0	8.3
15	21.3	8.4
20	21.5	8.5
25	21.7	8.6
30	22.0	8.6
35	22.1	8.7
40	22.3	8.8
45	22.5	8.9
50	22.6	8.9
55	22.8	9.0
60	23.0	9.0
65	23.2	9.1
70	23.4	9.2
75	23.7	9.3
80	23.9	9.4
85	24.2	9.5
90	24.6	9.7
95	25.0	9.8
97	25.4	10.0
98	25.8	10.2
99	26.6	10.5



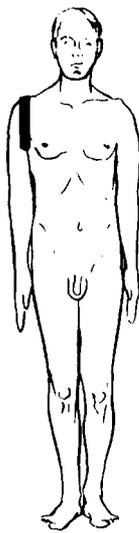
ANKLE CIRCUMFERENCE

Subject stands. Holding the tape slightly above (i. e., proximal to) the projections of the ankle bones, measure the minimum circumference of the right leg.

Mean: 22.68(.02) cm; 8.93(.01) in.
 Standard Deviation: 1.45(.01) cm; .57(.00) in.
 Range: 18-33 cm; 7.09-12.99 in.
 V = 6.39(.07)% N = 4061

Percentile Values

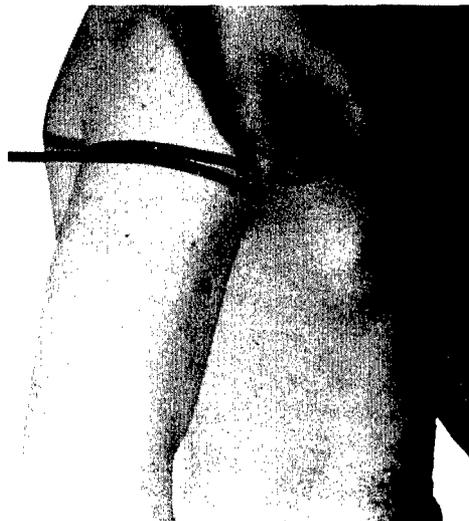
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	38.3	15.1
2	39.6	15.6
3	40.2	15.8
5	40.9	16.1
10	41.9	16.5
15	42.6	16.8
20	43.1	17.0
25	43.6	17.2
30	44.1	17.4
35	44.5	17.5
40	45.0	17.7
45	45.4	17.9
50	45.8	18.0
55	46.2	18.2
60	46.7	18.4
65	47.2	18.6
70	47.7	18.8
75	48.2	19.0
80	48.8	19.2
85	49.5	19.5
90	50.5	19.9
95	52.0	20.5
97	53.0	20.9
98	53.8	21.2
99	55.3	21.8



SCYE CIRCUMFERENCE

Subject stands, his right arm initially raised, and then lowered after the tape is in place. Measure the circumference of the scye with the tape placed as high as possible in the right armpit and passing over acromion as marked.

Mean: 45.96(.06) cm; 18.09(.02) in.
 Standard Deviation: 3.50(.04) cm; 1.38(.02) in.
 Range: 28-58 cm; 11.02-22.83 in.
 V = 7.62(.08)% N = 4060



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	25.9	10.2
2	26.6	10.5
3	27.0	10.6
5	27.6	10.9
10	28.5	11.2
15	29.1	11.5
20	29.5	11.6
25	30.0	11.8
30	30.3	11.9
35	30.7	12.1
40	31.0	12.2
45	31.3	12.3
50	31.6	12.4
55	32.0	12.6
60	32.3	12.7
65	32.7	12.9
70	33.1	13.0
75	33.6	13.2
80	34.1	13.4
85	34.8	13.7
90	35.5	14.0
95	36.5	14.4
97	37.2	14.6
98	37.7	14.8
99	38.5	15.2

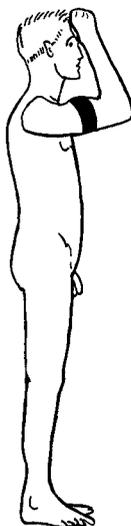
AXILLARY ARM CIRCUMFERENCE

Subject stands, his right arm initially raised and then lowered after the tape is in place. Holding the tape in a horizontal plane and as high as possible in the armpit, measure the circumference of the upper arm.

Mean: 31.85(.04) cm; 12.54(.02) in.
 Standard Deviation: 2.79(.03) cm; 1.10(.01) in.
 Range: 20-42 cm; 7.87-16.54 in.
 V = 8.76(.10)% N = 4060

Percentile Values

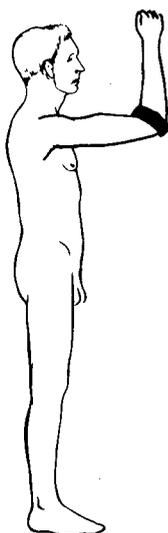
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	26.7	10.5
2	27.4	10.8
3	27.8	10.9
5	28.4	11.2
10	29.3	11.5
15	29.8	11.8
20	30.3	11.9
25	30.7	12.1
30	31.1	12.2
35	31.4	12.4
40	31.8	12.5
45	32.1	12.6
50	32.4	12.8
55	32.7	12.9
60	33.1	13.0
65	33.5	13.2
70	33.9	13.4
75	34.3	13.5
80	34.7	13.7
85	35.3	13.9
90	36.0	14.2
95	37.1	14.6
97	37.9	14.9
98	38.4	15.1
99	39.2	15.4



BICEPS CIRCUMFERENCE (FLEXED)

Subject bends his right arm and makes a fist while holding the upper arm horizontally. Using the tape, measure the maximum circumference around the biceps muscle.

Mean: 32.49(.04) cm; 12.79(.02) in.
 Standard Deviation: 2.71(.03) cm; 1.07(.01) in.
 Range: 21-43 cm; 8.27-16.93 in.
 V = 8.34(.09)% N = 4063



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	27.1	10.7
2	27.5	10.8
3	27.7	10.9
5	28.1	11.1
10	28.7	11.3
15	29.2	11.5
20	29.5	11.6
25	29.7	11.7
30	30.0	11.8
35	30.3	11.9
40	30.6	12.0
45	30.8	12.1
50	31.1	12.2
55	31.3	12.3
60	31.6	12.4
65	31.8	12.5
70	32.1	12.6
75	32.4	12.8
80	32.8	12.9
85	33.2	13.1
90	33.8	13.3
95	34.6	13.6
97	35.1	13.8
98	35.6	14.0
99	36.4	14.3

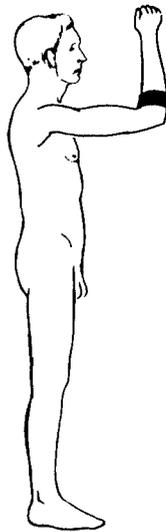
ELBOW CIRCUMFERENCE (FLEXED)

Subject bends his right arm at about a right angle and makes a fist. With the tape passing over the tip and through the crotch of the elbow, measure the circumference of the elbow.

Mean: 31.13(.03) cm; 12.26(.01) in.
 Standard Deviation: 2.03(.02) cm; .80(.01) in.
 Range: 21-39 cm; 8.27-15.35 in.
 V = 6.52(.07)% N = 4062

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	25.2	9.9
2	25.7	10.1
3	26.0	10.2
5	26.4	10.4
10	27.0	10.6
15	27.3	10.8
20	27.7	10.9
25	28.0	11.0
30	28.2	11.1
35	28.5	11.2
40	28.7	11.3
45	28.9	11.4
50	29.2	11.5
55	29.4	11.6
60	29.6	11.7
65	29.9	11.8
70	30.2	11.9
75	30.5	12.0
80	30.8	12.1
85	31.2	12.3
90	31.7	12.5
95	32.3	12.7
97	32.8	12.9
98	33.2	13.1
99	33.9	13.3



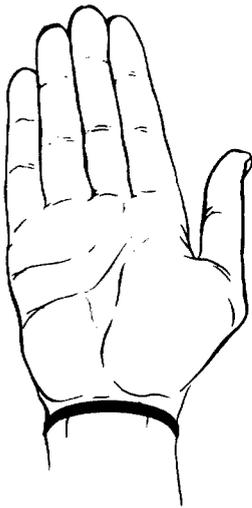
LOWER ARM CIRCUMFERENCE (FLEXED)

Subject bends his right arm at about a right angle and makes a fist. Holding the tape in a plane at right angles to the long axis of the forearm, measure the maximum circumference of the forearm.

Mean: 29.21(.03) cm; 11.50(.01) in.
 Standard Deviation: 1.86(.02) cm; .73(.01) in.
 Range: 22-39 cm; 8.66-15.35 in.
 V = 6.37(.07)% N = 4059

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	15.3	6.0
2	15.6	6.1
3	15.7	6.2
5	15.9	6.3
10	16.2	6.4
15	16.4	6.5
20	16.6	6.5
25	16.7	6.6
30	16.9	6.6
35	17.0	6.7
40	17.1	6.7
45	17.3	6.8
50	17.4	6.8
55	17.5	6.9
60	17.6	6.9
65	17.8	7.0
70	17.9	7.0
75	18.1	7.1
80	18.2	7.2
85	18.4	7.3
90	18.7	7.4
95	19.0	7.5
97	19.2	7.6
98	19.4	7.6
99	19.8	7.8



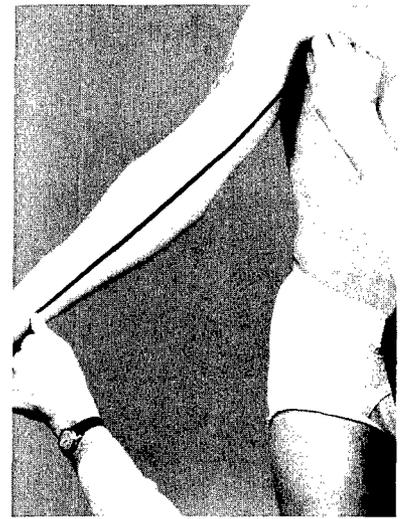
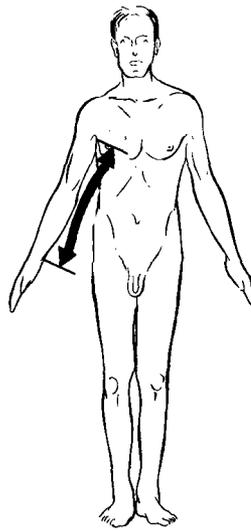
WRIST CIRCUMFERENCE

With the tape passing just proximal of the styloid process of the subject's right ulna, measure the minimum circumference of the wrist.

Mean: 17.39(.02) cm; 6.85(.01) in.
 Standard Deviation: 1.00(.01) cm; .40(.00) in.
 Range: 10-21 cm; 3.94-8.27 in.
 V = 5.78(.07)% N = 4057

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	43.4	17.1
2	44.4	17.5
3	44.9	17.7
5	45.7	18.0
10	46.8	18.4
15	47.5	18.7
20	48.1	18.9
25	48.5	19.1
30	49.0	19.3
35	49.3	19.4
40	49.7	19.6
45	50.0	19.7
50	50.4	19.8
55	50.7	20.0
60	51.1	20.1
65	51.5	20.3
70	51.9	20.4
75	52.4	20.6
80	52.8	20.8
85	53.4	21.0
90	54.1	21.3
95	55.2	21.7
97	55.9	22.0
98	56.4	22.2
99	57.3	22.6



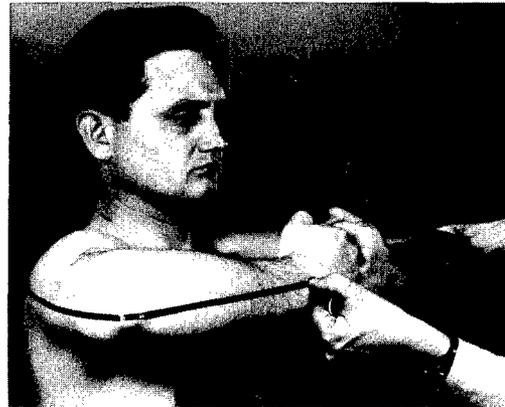
SLEEVE INSEAM

Subject stands, his right arm extended so that the hand is no more than a foot from his body. Using the tape, measure the distance from the front edge of the armpit to the notch beyond the radial styloid process at the thumb side of the wrist.

Mean: 50.38(.05) cm; 19.83(.02) in.
 Standard Deviation: 2.90(.04) cm; 1.14(.02) in.
 Range: 39-63 cm; 15.35-24.80 in.
 V = 5.76(.06)% N = 4052

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	76.7	30.2
2	77.9	30.7
3	78.5	30.9
5	79.4	31.3
10	80.6	31.7
15	81.5	32.1
20	82.3	32.4
25	83.0	32.7
30	83.5	32.9
35	84.1	33.1
40	84.6	33.3
45	85.1	33.5
50	85.5	33.7
55	86.0	33.9
60	86.5	34.1
65	87.0	34.2
70	87.5	34.5
75	88.0	34.7
80	88.7	34.9
85	89.5	35.2
90	90.3	35.6
95	91.5	36.0
97	92.5	36.4
98	93.4	36.8
99	94.7	37.3



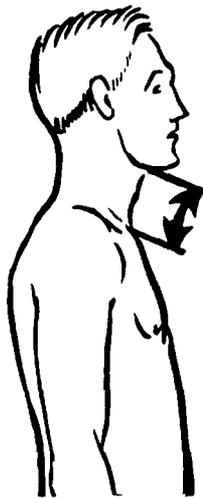
SLEEVE LENGTH (SPINE-TO-WRIST)

Subject stands, his arms horizontal, his elbows bent at about right angles, and his fists pressed together. With the tape held in a horizontal plane and passing over the tip of the right elbow, measure the distance from the spine to the end of the ulna styloid process at the little finger side of the wrist.

Mean: 85.45(.06) cm; 33.64(.02) in.
 Standard Deviation: 3.80(.04) cm; 1.50(.02) in.
 Range: 70-99 cm; 27.56-38.98 in.
 V = 4.44(.05)% N = 4048

Percentile Values

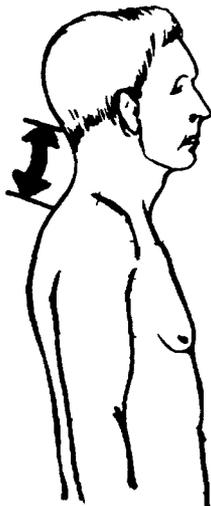
%	MM	IN.
1	46.8	1.8
2	51.0	2.0
3	54.0	2.1
5	58.5	2.3
10	65.6	2.6
15	69.7	2.7
20	72.9	2.9
25	75.7	3.0
30	78.2	3.1
35	80.4	3.2
40	82.5	3.2
45	84.8	3.3
50	87.1	3.4
55	88.9	3.5
60	90.7	3.6
65	92.4	3.6
70	95.1	3.7
75	97.7	3.8
80	100.1	3.9
85	102.5	4.0
90	106.9	4.2
95	112.3	4.4
97	116.8	4.6
98	119.8	4.7
99	124.0	4.9



ANTERIOR NECK LENGTH

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the tape, measure the surface distance from the marked point at the upper edge of the breast-bone (suprasternale) to the juncture of the chin and the neck.

Mean: 86.42(.25) mm; 3.40(.00) in.
 Standard Deviation: 16.25(.18) mm; .64(.00) in.
 Range: 35-135 mm; 1.38-5.31 in.
 V = 18.80(.22)% N = 4063



Percentile Values

%	MM	IN.
1	59.5	2.3
2	62.0	2.4
3	64.5	2.5
5	68.2	2.7
10	72.5	2.9
15	76.6	3.0
20	79.2	3.1
25	81.4	3.2
30	83.8	3.3
35	86.4	3.4
40	88.4	3.5
45	89.9	3.5
50	91.4	3.6
55	93.2	3.7
60	95.8	3.8
65	98.1	3.9
70	100.1	3.9
75	102.1	4.0
80	105.2	4.1
85	108.6	4.3
90	111.9	4.4
95	118.3	4.7
97	122.0	4.8
98	126.8	5.0
99	132.2	5.2

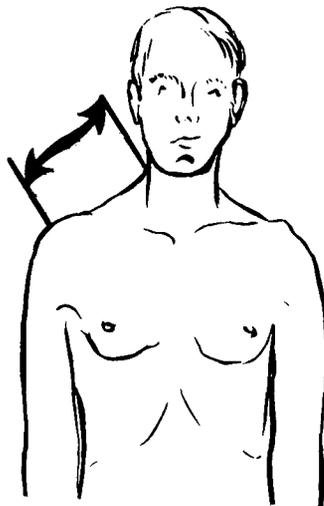
POSTERIOR NECK LENGTH

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the tape, measure the surface distance from the point marked at the base of the neck (cervicale) to the lowest point of the skull which can be felt with a finger among the neck muscles (this point may be at or below inion).

Mean: 92.34(.24) mm; 3.64(.01) in.
 Standard Deviation: 15.48(.17) mm; .61(.01) in.
 Range: 40-155 mm; 1.57-6.10 in.
 V = 16.75(.19)% N = 4062

Percentile Values

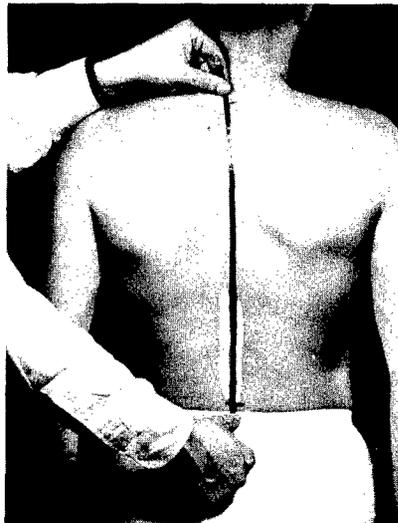
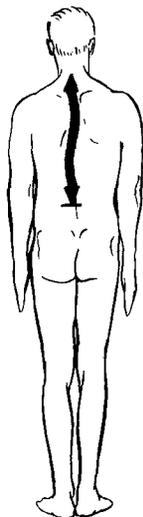
%	CM	IN.
1	14.0	5.5
2	14.4	5.7
3	14.6	5.7
5	15.0	5.9
10	15.4	6.1
15	15.8	6.2
20	16.1	6.3
25	16.3	6.4
30	16.5	6.5
35	16.7	6.6
40	16.9	6.6
45	17.1	6.7
50	17.2	6.8
55	17.4	6.9
60	17.6	6.9
65	17.8	7.0
70	18.0	7.1
75	18.2	7.2
80	18.5	7.3
85	18.7	7.4
90	19.0	7.5
95	19.5	7.7
97	19.9	7.8
98	20.2	8.0
99	20.6	8.1



SHOULDER LENGTH

Subject stands erect looking directly forward (head oriented in the Frankfort plane). Using the tape, measure the surface distance from the marked point on the right side of the neck to the marked point at the lateral edge of the right shoulder (acromion).

Mean: 17.20(.02) cm; 6.77(.01) in.
 Standard Deviation: 1.41(.01) cm; .56(.00) in.
 Range: 11-22 cm; 4.33-8.66 in.
 V = 8.20(.09)% N = 4048



Percentile Values

%	CM	IN.
1	37.6	14.8
2	39.7	15.6
3	40.2	15.8
5	40.8	16.1
10	41.7	16.4
15	42.3	16.6
20	42.8	16.8
25	43.2	17.0
30	43.7	17.2
35	44.1	17.3
40	44.4	17.5
45	44.7	17.6
50	45.0	17.7
55	45.4	17.9
60	45.7	18.0
65	46.0	18.1
70	46.4	18.3
75	46.9	18.4
80	47.3	18.6
85	47.8	18.8
90	48.5	19.1
95	49.4	19.4
97	50.0	19.7
98	50.5	20.0
99	51.2	20.2

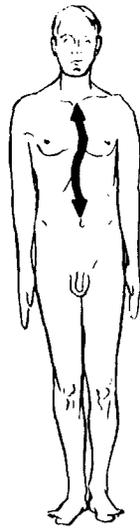
WAIST BACK

Subject stands erect. Using the tape, measure the surface distance from the marked point at the base of the neck (cervicale) to the marked point on the back of the waist.

Mean: 45.00(.04) cm; 17.72(.02) in.
 Standard Deviation: 2.73(.03) cm; 1.07(.01) in.
 Range: 30-58 cm; 11.81-22.83 in.
 V = 6.07(.07)% N = 4062

Percentile Values

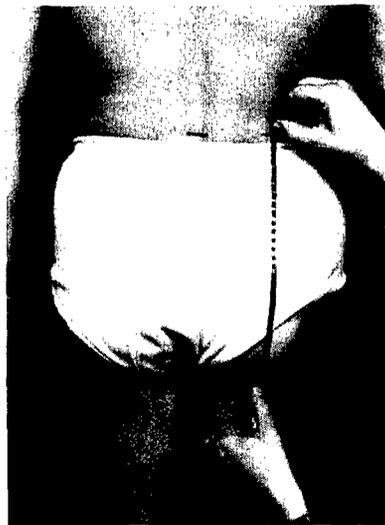
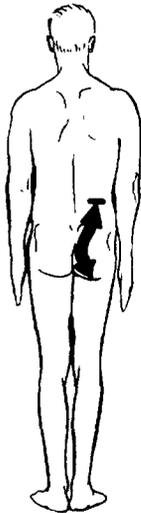
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	31.3	12.3
2	32.7	12.9
3	33.5	13.2
5	34.4	13.5
10	35.4	13.9
15	36.1	14.2
20	36.5	14.4
25	37.0	14.6
30	37.3	14.7
35	37.7	14.8
40	38.1	15.0
45	38.4	15.1
50	38.7	15.2
55	39.0	15.4
60	39.4	15.5
65	39.7	15.6
70	40.1	15.8
75	40.6	16.0
80	41.0	16.2
85	41.6	16.4
90	42.3	16.7
95	43.3	17.0
97	44.1	17.4
98	44.8	17.6
99	45.9	18.1



WAIST FRONT

Subject stands erect. Using the tape, measure the surface distance from the marked point at the upper edge of the breastbone (suprasternale) to the waist point marked on the midline of the abdomen.

Mean: 38.71(.04) cm; 15.24(.02) in.
 Standard Deviation: 2.84(.03) cm; 1.12(.01) in.
 Range: 27-54 cm; 10.63-21.26 in.
 V = 7.33(.08)% N = 4043



GLUTEAL ARC

Subject stands. Using the tape, measure the surface arc over the right buttock from the gluteal furrow to the line marked on the waist directly over the buttock.

Mean: 29.75(.04) cm; 11.71(.02) in.
 Standard Deviation: 2.33(.03) cm; .92(.01) in.
 Range: 20-44 cm; 7.87-17.32 in.
 V = 7.83(.09)% N = 4057

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	24.6	9.7
2	25.3	10.0
3	25.7	10.1
5	26.3	10.4
10	27.2	10.7
15	27.6	10.9
20	28.0	11.0
25	28.3	11.2
30	28.6	11.3
35	28.9	11.4
40	29.2	11.5
45	29.4	11.6
50	29.7	11.7
55	29.9	11.8
60	30.2	11.9
65	30.5	12.0
70	30.8	12.1
75	31.1	12.2
80	31.5	12.4
85	31.9	12.5
90	32.5	12.8
95	33.3	13.1
97	34.1	13.4
98	34.9	13.7
99	37.7	14.8

Percentile Values

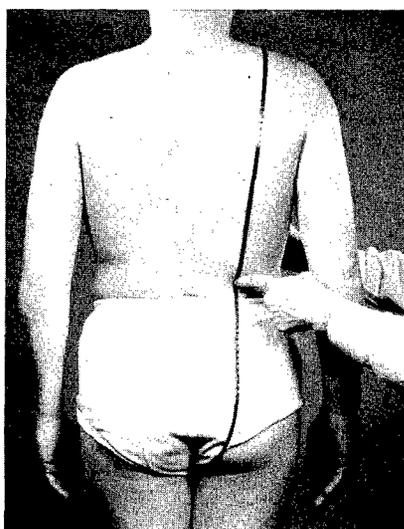
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	60.3	23.7
2	61.7	24.3
3	62.5	24.6
5	63.7	25.1
10	65.5	25.8
15	66.7	26.2
20	67.6	26.6
25	68.3	26.9
30	69.0	27.2
35	69.7	27.4
40	70.3	27.7
45	70.9	27.9
50	71.5	28.2
55	72.1	28.4
60	72.7	28.6
65	73.3	28.9
70	74.0	29.1
75	74.7	29.4
80	75.6	29.8
85	76.7	30.2
90	78.2	30.8
95	80.2	31.6
97	81.8	32.2
98	83.1	32.7
99	85.1	33.5



CROTCH LENGTH

Subject stands with his legs slightly apart. With the tape passing through the crotch and over the right buttock, measure the surface distance from the point marked on the front of the waist to the waist line marked directly above the buttock.

Mean: 71.63(.08) cm; 28.20(.03) in.
 Standard Deviation: 5.08(.06) cm; 2.00(.02) in.
 Range: 51-97 cm; 20.08-38.19 in.
 V = 7.09(.08)% N = 4058



Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	148.0	58.3
2	150.2	59.1
3	151.5	59.6
5	153.0	60.2
10	155.4	61.2
15	157.1	61.9
20	158.5	62.4
25	159.7	62.9
30	160.9	63.4
35	161.8	63.7
40	162.8	64.1
45	163.7	64.4
50	164.5	64.8
55	165.4	65.1
60	166.3	65.5
65	167.3	65.9
70	168.3	66.3
75	169.5	66.7
80	170.7	67.2
85	172.2	67.8
90	174.1	68.6
95	177.0	69.7
97	179.0	70.5
98	180.2	70.9
99	182.0	71.7

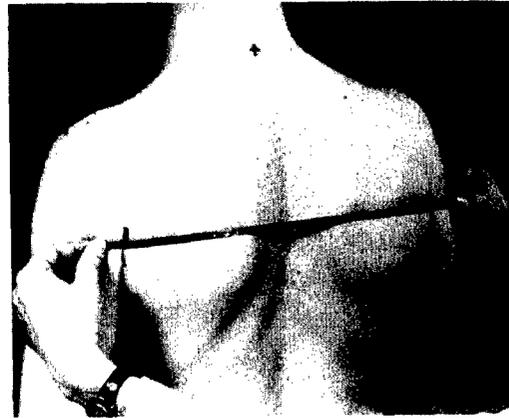
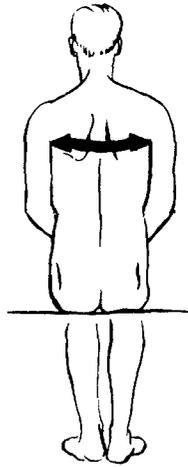
VERTICAL TRUNK CIRCUMFERENCE

Subject stands with his legs slightly apart. With the tape passing through the crotch and over the midpoints of the right shoulder and the right buttock, measure the vertical circumference of the torso. The tape should be pressed into the concavity of the small of the back so that it follows the body contour at all points.

Mean: 164.63(.11) cm; 64.81(.04) in.
 Standard Deviation: 7.31(.08) cm; 2.88(.03) in.
 Range: 139-189 cm; 54.72-74.41 in.
 V = 4.44(.05)% N = 4060

Percentile Values

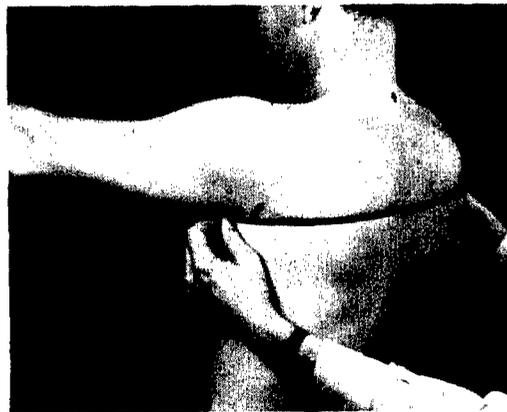
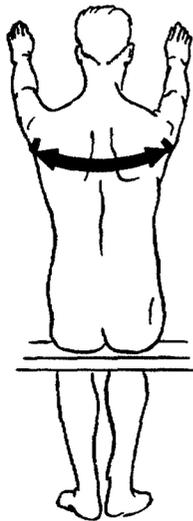
%	CM	IN.
1	41.5	16.3
2	42.5	16.7
3	43.1	17.0
5	44.0	17.3
10	45.3	17.8
15	46.2	18.2
20	46.9	18.5
25	47.5	18.7
30	48.1	18.9
35	48.6	19.1
40	49.0	19.3
45	49.5	19.4
50	49.9	19.6
55	50.3	19.8
60	50.8	20.0
65	51.2	20.2
70	51.7	20.4
75	52.2	20.6
80	52.8	20.8
85	53.5	21.1
90	54.4	21.4
95	55.8	22.0
97	56.6	22.3
98	57.2	22.5
99	58.2	22.9



INTERSCYE

Subject sits erect, his hands on his knees. Using the tape, measure the minimum surface distance between the bottoms of the marked points near the armpits on the subject's back (scye points.).

Mean: 49.83(.06) cm; 19.62(.02) in.
 Standard Deviation: 3.56(.04) cm; 1.40(.02) in.
 Range: 31-62 cm; 12.20-24.41 in.
 V = 7.14(.08)% N = 4061



INTERSCYE MAXIMUM

Subject sits erect, his arms horizontal and extended forward as far as possible. Using the tape, measure the minimum surface distance between the bottoms of the marked points near the armpits on the subject's back (scye points).

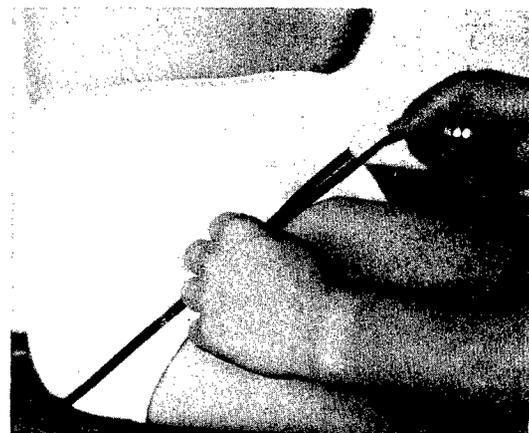
Mean: 58.05(.05) cm; 22.85(.02) in.
 Standard Deviation: 3.38(.04) cm; 1.33(.02) in.
 Range: 45-69 cm; 17.72-27.17 in.
 V = 5.82(.06)% N = 4058

Percentile Values

%	CM	IN.
1	50.3	19.8
2	51.2	20.2
3	51.8	20.4
5	52.7	20.7
10	53.9	21.2
15	54.6	21.5
20	55.3	21.8
25	55.8	22.0
30	56.3	22.2
35	56.8	22.4
40	57.2	22.5
45	57.6	22.7
50	58.0	22.9
55	58.5	23.0
60	58.9	23.2
65	59.3	23.4
70	59.8	23.5
75	60.3	23.8
80	61.0	24.0
85	61.7	24.3
90	62.6	24.6
95	63.7	25.1
97	64.5	25.4
98	65.1	25.6
99	66.1	26.0

Percentile Values

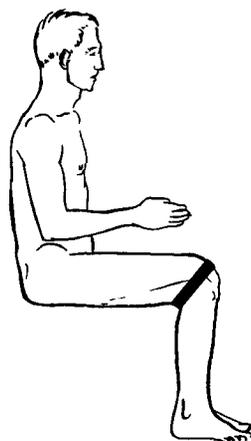
%	CM	IN.
1	91.6	36.1
2	93.0	36.6
3	93.9	37.0
5	95.1	37.4
10	97.2	38.3
15	98.9	38.9
20	100.3	39.5
25	101.1	39.8
30	102.0	40.2
35	102.9	40.5
40	103.8	40.9
45	104.6	41.2
50	105.5	41.5
55	106.4	41.9
60	107.3	42.2
65	108.3	42.6
70	109.4	43.1
75	110.5	43.5
80	111.9	44.0
85	113.6	44.7
90	115.6	45.5
95	118.7	46.7
97	121.0	47.6
98	122.6	48.3
99	125.2	49.3



BUTTOCK CIRCUMFERENCE, SITTING

Subject sits erect with his knees bent at about right angles. With the tape passing just under the buttocks where they touch the sitting surface and brought up at about a 45-degree angle across the lap in the furrow between the torso and legs, measure the circumference of the buttocks.

Mean: 106.02(.11) cm; 41.74(.04) in.
 Standard Deviation: 7.16(.08) cm; 2.82(.03) in.
 Range: 85-133 cm; 33.46-52.36 in.
 V = 6.75(.08)% N = 4062



Percentile Values

%	CM	IN.
1	34.3	13.5
2	34.8	13.7
3	35.1	13.8
5	35.6	14.0
10	36.3	14.3
15	36.8	14.5
20	37.2	14.6
25	37.5	14.8
30	37.9	14.9
35	38.2	15.0
40	38.5	15.1
45	38.7	15.3
50	39.0	15.4
55	39.3	15.5
60	39.6	15.6
65	39.9	15.7
70	40.3	15.9
75	40.7	16.0
80	41.1	16.2
85	41.6	16.4
90	42.1	16.6
95	43.0	16.9
97	43.7	17.2
98	44.1	17.4
99	45.0	17.7

KNEE CIRCUMFERENCE, SITTING

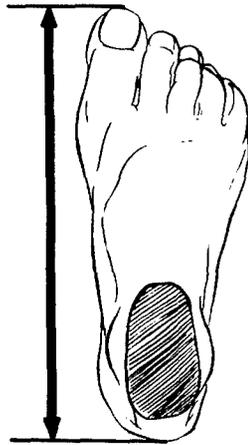
Subject sits erect with his knees bent at about right angles. With the tape passing under the popliteal area of the right leg and brought up at about a 45-degree angle over the knee, measure the maximum circumference of the right knee.

Mean: 39.10(.04) cm; 15.39(.02) in.
 Standard Deviation: 2.33(.03) cm; .92(.01) in.
 Range: 29-52 cm; 11.42-20.47 in.
 V = 5.96(.07)% N = 4059

THE FOOT

Percentile Values

%	MM	IN.
1	240.5	9.5
2	243.4	9.6
3	245.3	9.7
5	248.0	9.8
10	252.1	9.9
15	255.0	10.0
20	257.3	10.1
25	259.2	10.2
30	260.6	10.3
35	262.2	10.3
40	263.7	10.4
45	265.1	10.4
50	266.7	10.5
55	268.2	10.6
60	269.7	10.6
65	271.0	10.7
70	272.7	10.7
75	274.5	10.8
80	276.3	10.9
85	278.4	11.0
90	281.2	11.1
95	285.9	11.3
97	288.0	11.3
98	290.5	11.4
99	295.1	11.6



FOOT LENGTH

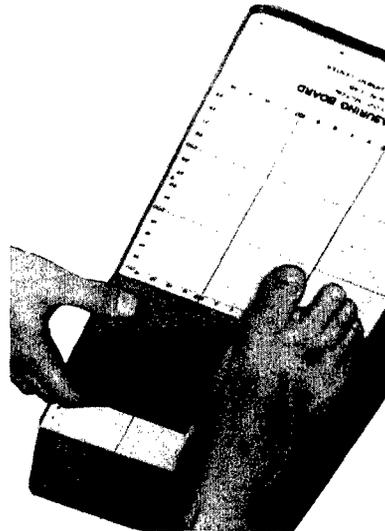
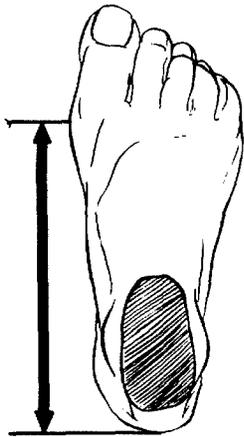
Subject stands with his right foot in the foot box, the foot just touching the side and rear walls and the long axis parallel to the side wall, his weight equally distributed on both feet. Using the scale on the base of the box, measure from the rear wall to the tip of the longest toe.

Mean: 266.75(.18) mm; 10.50(.00) in.

Standard Deviation: 11.48(.13) mm; .45(.00) in.

Range: 225-311 mm; 8.86-12.24 in.

V = 4.30(.05)% N = 4063



Percentile Values

%	MM	IN.
1	174.6	6.9
2	176.4	6.9
3	177.6	7.0
5	179.7	7.1
10	182.9	7.2
15	185.0	7.3
20	186.6	7.3
25	188.0	7.4
30	189.7	7.5
35	190.8	7.5
40	191.9	7.6
45	192.9	7.6
50	194.1	7.6
55	195.1	7.7
60	196.1	7.7
65	197.2	7.8
70	198.5	7.8
75	199.9	7.9
80	201.1	7.9
85	202.6	8.0
90	204.6	8.1
95	207.7	8.2
97	210.0	8.3
98	211.6	8.3
99	214.3	8.4

INSTEP LENGTH

Subject stands with his right foot in the foot box, the foot just touching the side and rear walls and the long axis parallel to the side wall, his weight equally distributed on both feet. Using the scale on the base of the box, measure from the rear wall to the widest part of the foot.

Mean: 193.95(.13) mm; 7.64(.05) in.

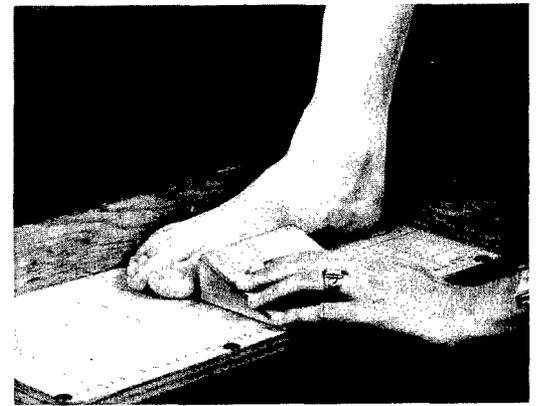
Standard Deviation: 8.57(.09) mm; .34(.00) in.

Range: 163-225 mm; 6.42-8.86 in.

V = 4.42(.05)% N = 4063

Percentile Values

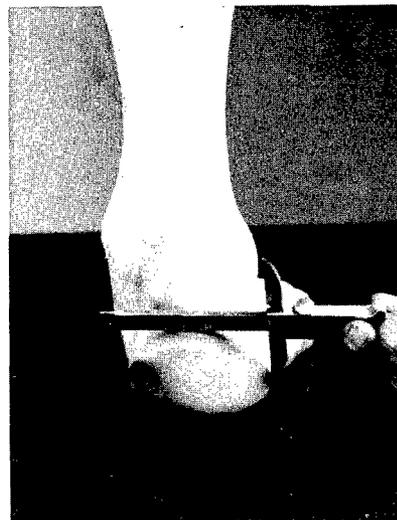
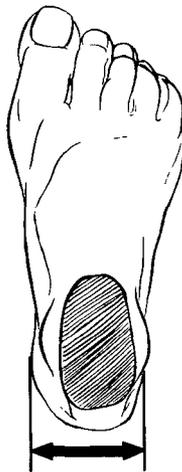
%	MM	IN.
1	86.3	3.40
2	87.4	3.44
3	88.1	3.47
5	89.0	3.50
10	90.7	3.57
15	91.7	3.61
20	92.5	3.64
25	93.2	3.67
30	93.8	3.69
35	94.4	3.72
40	95.0	3.74 ✓
45	95.6	3.76
50	96.1	3.78
55	96.8	3.81
60	97.6	3.84
65	98.3	3.87
70	99.0	3.90
75	99.7	3.93
80	100.5	3.96
85	101.4	3.99
90	102.5	4.03
95	104.2	4.10
97	105.4	4.15
98	106.6	4.20
99	108.3	4.36



FOOT BREADTH

Subject stands with his right foot in the foot box, the foot just touching the side and rear walls and the long axis parallel to the side wall, his weight equally distributed on both feet. Using the scale on the base of the box, measure from the side wall to the widest part of the foot.

Mean: 96.51(.07) mm; 3.80(.00) in.
 Standard Deviation: 4.73(.05) mm; .19(.00) in.
 Range: 81-118 mm; 3.19-4.65 in.
 V = 4.90(.05)% N = 4060



Percentile Values

%	MM	IN.
1	58.5	2.30
2	59.4	2.34
3	60.0	2.36
5	60.9	2.40
10	62.2	2.45
15	63.1	2.49
20	63.9	2.51
25	64.5	2.54
30	65.1	2.56
35	65.5	2.58
40	66.0	2.60
45	66.4	2.62
50	66.9	2.63
55	67.3	2.65
60	67.8	2.67
65	68.3	2.69
70	68.8	2.71
75	69.4	2.73
80	70.0	2.76
85	70.8	2.79
90	71.9	2.83
95	73.0	2.87
97	74.4	2.93
98	75.2	2.96
99	76.4	3.01

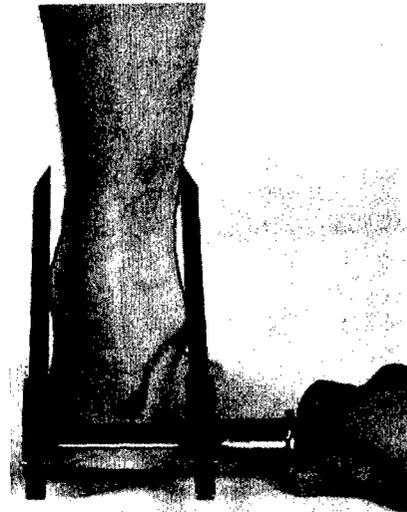
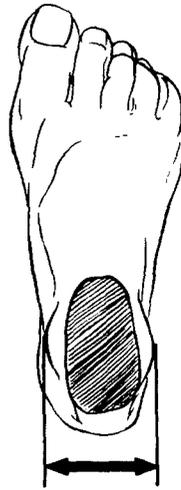
HEEL BREADTH

Subject stands with his weight equally distributed on both feet. From behind the subject and with the bar of the sliding caliper held in a plane at right angles to the long axis of the foot, measure the maximum breadth of the right heel behind the projections of the ankle bones.

Mean: 66.98(.06) mm; 2.64(.00) in.
 Standard Deviation: 3.87(.04) mm; .15(.00) in.
 Range: 54-83 mm; 2.13-3.27 in.
 V = 5.79(.06)% N = 4061

Percentile Values

%	MM	IN.
1	66.4	2.61
2	67.3	2.65
3	67.9	2.67
5	68.7	2.70
10	70.0	2.76
15	71.0	2.79
20	71.7	2.82
25	72.2	2.84
30	72.7	2.86
35	73.3	2.89
40	73.8	2.91
45	74.3	2.93
50	74.8	2.95
55	75.3	2.96
60	75.8	2.98
65	76.3	3.00
70	76.8	3.02
75	77.3	3.04
80	78.0	3.07
85	78.7	3.10
90	79.8	3.14
95	81.1	3.19
97	82.2	3.24
98	83.0	3.27
99	84.3	3.32



BIMALLEOLAR BREADTH

Subject stands, his legs slightly apart, and his weight equally distributed on both feet. Holding the bar of the sliding caliper perpendicular to the long axis of the foot, measure horizontally across the maximum protrusions of the medial and lateral ankle bones of the right foot. (The caliper was used in the survey, but the anthropometer is recommended for future use.)

Mean: 74.86(.06) mm; 2.95(.00) in.
 Standard Deviation: 3.82(.04) mm; .15(.00) in.
 Range: 62-91 mm; 2.44-3.58 in.
 V = 5.10(.06)% N = 4063

Percentile Values

%	MM	IN.
1	57.0	2.2
2	58.5	2.3
3	59.3	2.3
5	60.2	2.4
10	62.1	2.4
15	63.8	2.5
20	64.7	2.5
25	65.2	2.6
30	66.0	2.6
35	67.5	2.7
40	68.4	2.7
45	69.1	2.7
50	69.6	2.7
55	70.0	2.8
60	70.3	2.8
65	70.9	2.8
70	71.8	2.8
75	72.8	2.9
80	74.2	2.9
85	75.1	3.0
90	76.2	3.0
95	79.4	3.1
97	80.5	3.2
98	81.4	3.2
99	83.6	3.3



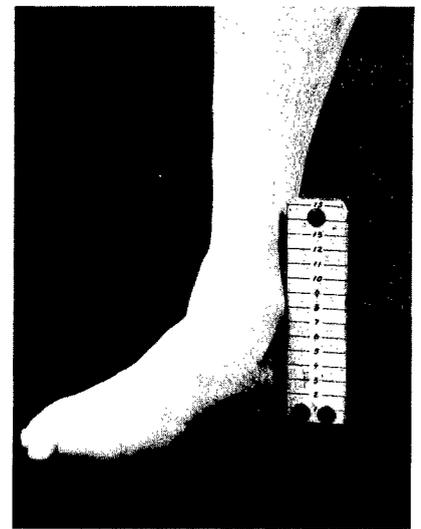
LATERAL MALLEOLUS HEIGHT

Subject stands, preferably on a table, with his weight equally distributed on both feet, and the right foot slightly forward. Press the surface of the measuring block against the side of the right foot and measure the height of the most projecting point of the lateral malleolus (to the nearest 1/2 cm.)

Mean: 69.38(.09) mm; 2.73(.00) in.
 Standard Deviation: 5.65(.06) mm; .22(.00) in.
 Range: 51-94 mm; 2.01-3.70 in.
 V = 8.14(.09)% N = 4063

Percentile Values

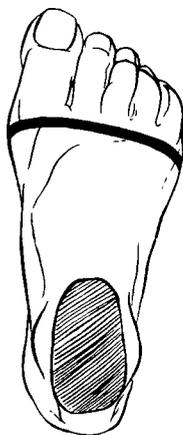
%	MM	IN.
1	75.5	3.0
2	77.1	3.0
3	78.2	3.1
5	79.5	3.1
10	81.2	3.2
15	82.2	3.2
20	83.1	3.3
25	84.0	3.3
30	84.9	3.3
35	85.8	3.4
40	86.5	3.4
45	87.3	3.4
50	87.9	3.5
55	88.6	3.5
60	89.3	3.5
65	90.0	3.5
70	90.7	3.6
75	91.4	3.6
80	92.2	3.6
85	93.1	3.7
90	94.2	3.7
95	96.2	3.8
97	97.7	3.8
98	99.0	3.9
99	100.8	4.0



MEDIAL MALLEOLUS HEIGHT

Subject stands, preferably on a table, with his weight equally distributed on both feet, and the right foot slightly forward. Press the surface of the measuring block against the medial malleolus of the right foot and measure the height of its most projecting point (to the nearest 1/2 cm).

Mean: 87.73(.08) mm; 3.45(.00) in.
 Standard Deviation: 5.32(.06) mm; .21(.00) in.
 Range: 66-109 mm; 2.60-4.29 in.
 V = 6.06(.07)% N = 4062



BALL OF FOOT CIRCUMFERENCE

Subject stands with the tape under the ball of his right foot and his weight equally distributed on both feet. Measure the maximum circumference around the distal ends of the protuberances of the metatarsal bones.

Mean: 24.52(.02) cm; 9.65(.01) in.
 Standard Deviation: 1.22(.01) cm; .48(.00) in.
 Range: 20-32 cm; 7.87-12.60 in.
 V = 4.98(.06)% N = 4050

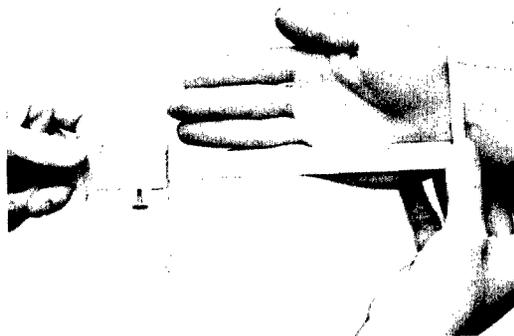
Percentile Values

%	CM	IN.
1	21.8	8.6
2	22.1	8.7
3	22.3	8.8
5	22.6	8.9
10	23.1	9.1
15	23.4	9.2
20	23.6	9.3
25	23.8	9.4
30	23.9	9.4
35	24.1	9.5
40	24.2	9.5
45	24.4	9.6
50	24.5	9.6
55	24.7	9.7
60	24.8	9.8
65	25.0	9.8
70	25.1	9.9
75	25.3	10.0
80	25.5	10.0
85	25.7	10.1
90	26.1	10.3
95	26.5	10.4
97	26.8	10.6
98	27.1	10.7
99	27.5	10.8

THE HAND

Percentile Values

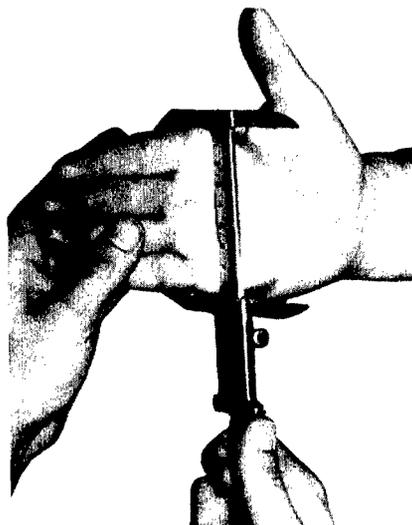
%	MM	IN.
1	170.9	6.7
2	172.9	6.8
3	174.2	6.9
5	175.9	6.9
10	179.3	7.1
15	181.4	7.1
20	183.1	7.2
25	184.4	7.3
30	185.6	7.3
35	186.9	7.4
40	188.1	7.4
45	189.0	7.4
50	189.8	7.5
55	190.9	7.5
60	192.1	7.6
65	193.3	7.6
70	194.5	7.7
75	196.1	7.7
80	197.8	7.8
85	199.3	7.9
90	201.4	7.9
95	204.4	8.0
97	206.5	8.1
98	208.1	8.2
99	210.5	8.3



HAND LENGTH

Subject's right hand is extended, palm up. With the bar of the sliding caliper lying along his palm, measure the distance from the proximal edge of the navicular bone at the wrist to the tip of the middle finger.

Mean: 190.23(.13) mm; 7.49(.01) in.
 Standard Deviation: 8.60(.09) mm; .34(.00) in.
 Range: 149-222 mm; 5.87-8.74 in.
 V = 4.52(.05)% N = 4063



Percentile Values

%	MM	IN.
1	79.3	3.12
2	80.2	3.16
3	80.8	3.18
5	81.7	3.22
10	83.3	3.28
15	84.1	3.31
20	84.7	3.34
25	85.4	3.36
30	86.0	3.39
35	86.6	3.41
40	87.2	3.43
45	87.8	3.46
50	88.5	3.49
55	88.9	3.50
60	89.2	3.51
65	89.7	3.53
70	90.4	3.56
75	91.1	3.59
80	91.8	3.61
85	92.6	3.65
90	93.8	3.69
95	95.1	3.74
97	96.1	3.78
98	96.9	3.81
99	98.1	3.86

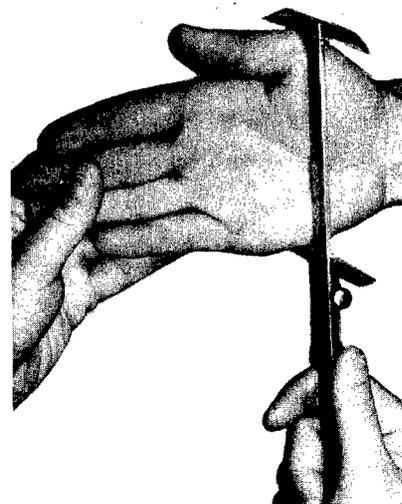
HAND BREADTH AT METACARPALE

Subject's right hand is extended, palm up. With the bar of the sliding caliper lying across his palm, measure the maximum breadth across the distal ends of the metacarpal bones (knuckles).

Mean: 88.33(.06) mm; 3.48(.00) in.
 Standard Deviation: 4.11(.04) mm; .16(.00) in.
 Range: 76-104 mm; 2.99-4.09 in.
 V = 4.65(.05)% N = 4058

Percentile Values

%	MM	IN.
1	91.2	3.59
2	92.5	3.64
3	93.4	3.68
5	94.7	3.73
10	96.6	3.80
15	98.3	3.87
20	99.1	3.90
25	99.8	3.93
30	100.5	3.96
35	101.3	3.99
40	102.0	4.02
45	102.8	4.05
50	103.7	4.08
55	104.1	4.10
60	104.7	4.12
65	105.4	4.15
70	106.1	4.18
75	107.0	4.21
80	108.0	4.25
85	109.1	4.30
90	110.4	4.35
95	112.2	4.42
97	113.6	4.47
98	114.6	4.51
99	116.1	4.57



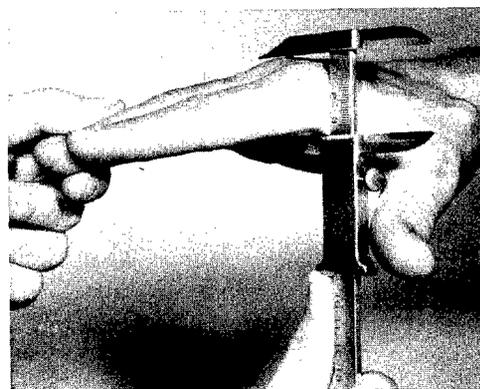
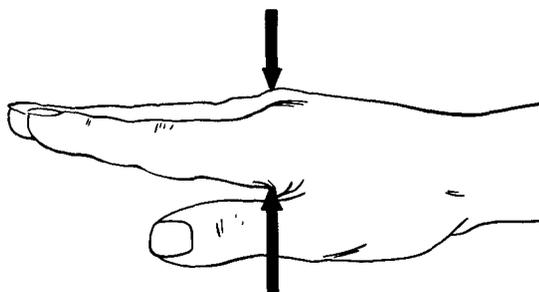
HAND BREADTH AT THUMB

Subject's right hand is extended, palm up, with the thumb lying along side and in the plane of the palm. With the bar of the sliding caliper resting on the palm and the caliper's fixed arm at the knuckle (the joint of the metacarpal bone and the first phalanx) of the thumb, measure the breadth at right angles to the long axis of the hand.

Mean: 103.49(.08) mm; 4.07(.00) in.
 Standard Deviation: 5.31(.06) mm; .21(.00) in.
 Range: 82-121 mm; 3.23-4.76 in.
 V = 5.16(.06)% N = 4062

Percentile Values

%	MM	IN.
1	25.4	1.00
2	25.9	1.02
3	26.3	1.03
5	26.7	1.05
10	27.4	1.08
15	27.9	1.10
20	28.3	1.11
25	28.6	1.13
30	28.9	1.14
35	29.1	1.14
40	29.3	1.15
45	29.5	1.16
50	29.7	1.17
55	29.9	1.18
60	30.1	1.18
65	30.3	1.19
70	30.5	1.20
75	30.7	1.21
80	31.0	1.22
85	31.4	1.24
90	31.8	1.25
95	32.5	1.28
97	33.1	1.30
98	33.5	1.32
99	34.2	1.35



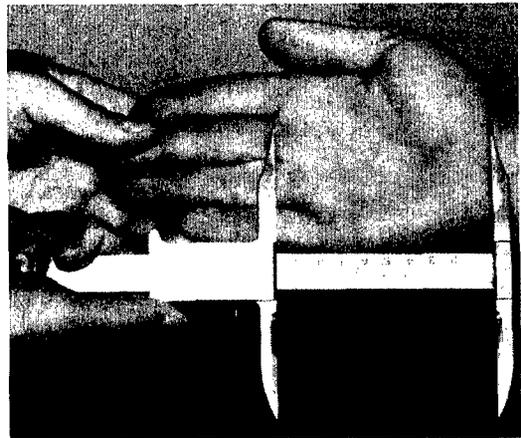
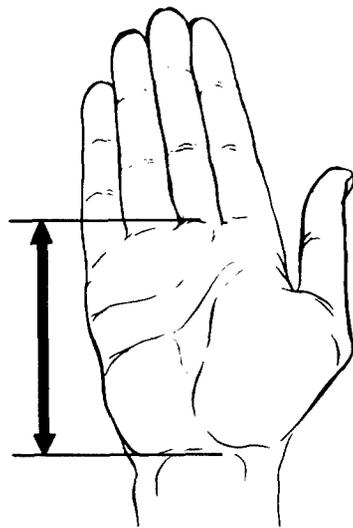
THICKNESS AT METACARPALE III

Subject's right hand is held with the fingers extended. Using the sliding caliper, measure the thickness of the knuckle (the joint of the metacarpal bone and the first phalanx) of the middle finger.

Mean: 29.67(.03) mm; 1.17(.00) in.
 Standard Deviation: 1.80(.02) mm; .07(.00) in.
 Range: 19-39 mm; .75-1.54 in.
 V = 6.07(.07)% N = 4061

Percentile Values

<u>%</u>	<u>MM</u>	<u>IN.</u>
1	95.7	3.77
2	97.0	3.82
3	97.8	3.85
5	98.9	3.89
10	100.8	3.97
15	102.1	4.02
20	103.3	4.07
25	104.0	4.10
30	104.7	4.12
35	105.4	4.15
40	106.2	4.18
45	107.0	4.21
50	107.7	4.24
55	108.5	4.27
60	109.0	4.29
65	109.5	4.31
70	110.4	4.35
75	111.4	4.38
80	112.4	4.42
85	113.6	4.47
90	114.8	4.52
95	116.9	4.60
97	118.1	4.65
98	119.0	4.69
99	120.4	4.74



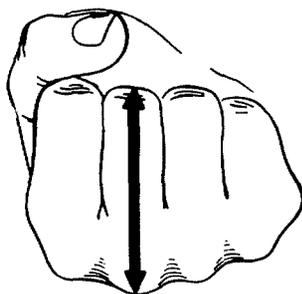
PALM LENGTH

Subject's right hand is extended, palm up. With the bar of the sliding caliper resting on the palm, measure from the proximal edge of the navicular bone at the wrist to the skin furrow formed where the middle finger folds upon the palm.

Mean: 107.73(.09) mm; 4.24(.00) in.
 Standard Deviation: 5.43(.06) mm; .21(.00) in.
 Range: 86-128 mm; 3.39-5.04 in.
 V = 5.04(.06)% N = 4062

Percentile Values

<u>%</u>	<u>MM</u>	<u>IN.</u>
1	60.9	2.40
2	61.8	2.43
3	62.4	2.46
5	63.2	2.49
10	64.0	2.52
15	64.6	2.54
20	65.2	2.57
25	65.7	2.59
30	66.2	2.61
35	66.6	2.62
40	67.0	2.64
45	67.4	2.65
50	67.8	2.67
55	68.3	2.69
60	68.6	2.70
65	68.9	2.71
70	69.2	2.73
75	69.6	2.74
80	70.2	2.76
85	70.9	2.79
90	71.7	2.82
95	72.5	2.85
97	73.4	2.89
98	74.0	2.91
99	75.0	2.95



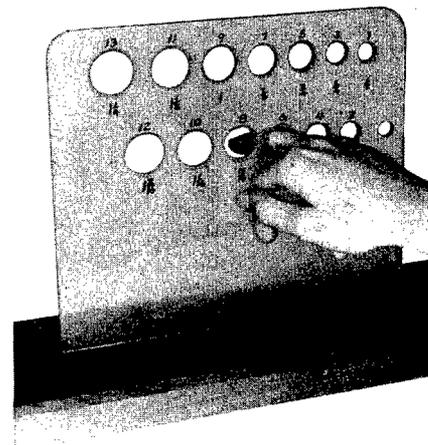
FIRST PHALANX III LENGTH

Subject's right hand is held in a fist. Using the sliding caliper, measure the length of the first segment of the middle finger across the surfaces of the third metacarpal and the second phalanx.

Mean: 67.78(.05) mm; 2.67(.00) in.
 Standard Deviation: 2.97(.04) mm; .12(.00) in.
 Range: 56-78 mm; 2.21-3.07 in.
 V = 4.38(.06)% N = 2955

Percentile Values

%	MM	IN.
1	19.4	.77
2	19.7	.77
3	19.8	.78
5	20.0	.79
10	20.3	.80
15	20.6	.81
20	20.8	.82
25	20.9	.82
30	21.1	.83
35	21.2	.84
40	21.4	.84
45	21.5	.85
50	21.7	.85
55	21.8	.86
60	22.0	.87
65	22.1	.87
70	22.3	.88
75	22.5	.89
80	22.7	.89
85	22.9	.90
90	23.2	.91
95	23.6	.93
97	23.9	.94
98	24.1	.95
99	24.4	.96



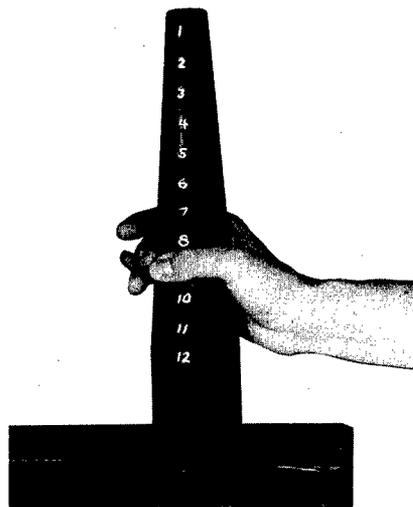
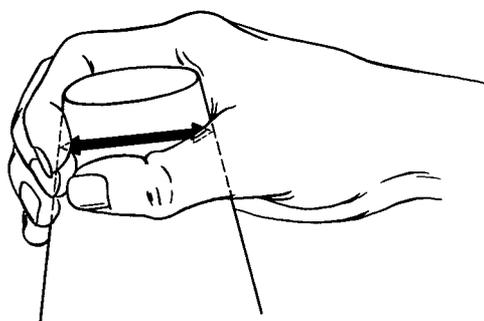
FINGER DIAMETER III

Subject's right middle finger is inserted into a series of graduated holes. Record the diameter of the hole which most closely approximates the maximum diameter of the finger.

Mean: 21.75(.02) mm; .86(.00) in.
 Standard Deviation: 1.19(.01) mm; .05(.00) in.
 Range: 19-25 mm; .75-1.00 in.
 V = 5.48(.06)% N = 4063

Percentile Values

%	MM	IN.
1	38.6	1.52
2	39.6	1.56
3	40.4	1.59
5	41.2	1.62
10	42.4	1.67
15	43.2	1.70
20	43.9	1.73
25	44.5	1.75
30	45.0	1.77
35	45.5	1.79
40	45.7	1.80
45	46.2	1.82
50	46.5	1.83
55	47.0	1.85
60	47.5	1.87
65	47.8	1.88
70	48.3	1.90
75	48.8	1.92
80	49.3	1.94
85	50.0	1.97
90	50.8	2.00
95	52.1	2.05
97	53.1	2.09
98	53.9	2.12
99	54.9	2.16



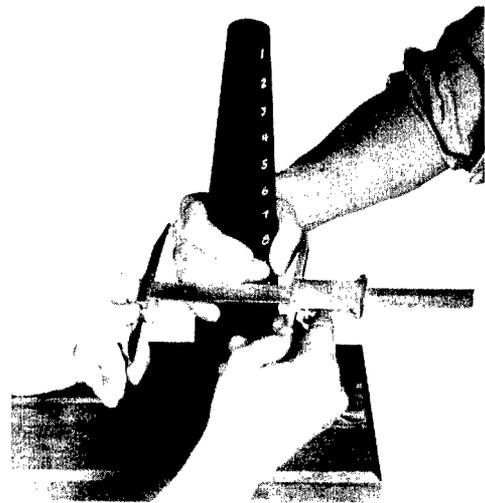
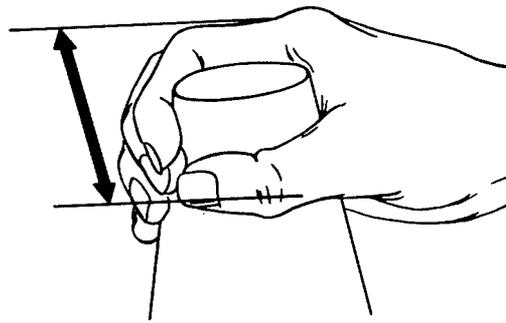
GRIP DIAMETER (INSIDE)

Subject holds a cone around the largest circumference that he can grasp with his thumb and middle finger just touching. Record the diameter of the cone corresponding to this maximum circumference.

Mean: 48.20(.05) mm; 1.90(.00) in.
 Standard Deviation: 3.43(.04) mm; .14(.00) in.
 Range: 35-67 mm; 1.37-2.63 in.
 V = 7.12(.08)% N = 4062

Percentile Values

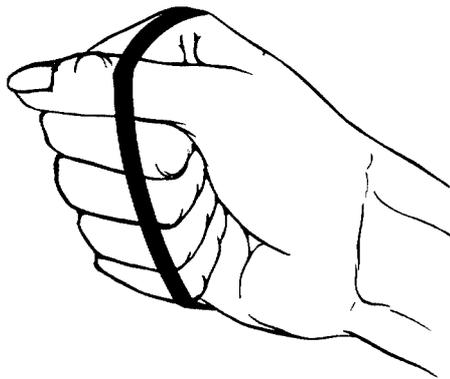
%	MM	IN.
1	91.0	3.58
2	92.4	3.64
3	93.3	3.67
5	94.6	3.72
10	96.7	3.81
15	97.9	3.85
20	99.1	3.90
25	100.0	3.94
30	100.9	3.97
35	101.7	4.00
40	102.4	4.03
45	103.1	4.06
50	103.9	4.09
55	104.6	4.12
60	105.3	4.15
65	106.1	4.18
70	106.8	4.20
75	107.7	4.24
80	108.6	4.28
85	109.6	4.31
90	110.9	4.37
95	112.8	4.44
97	114.1	4.49
98	114.9	4.52
99	116.2	4.57



GRIP DIAMETER (OUTSIDE)

Subject holds a cone at the largest circumference that he can grasp with his thumb and middle finger just touching. Using the sliding caliper, measure from the joint of the first and second phalanges of the thumb to the knuckle of the middle finger (metacarpal-first phalanx joint).

Mean: 103.87(.08) mm; 4.09(.00) in.
 Standard Deviation: 5.27(.06) mm; .21(.00) in.
 Range: 80-120 mm; 3.15-4.72 in.
 V = 5.07(.06)% N = 4063



Percentile Values

%	CM	IN.
1	26.0	10.2
2	26.5	10.4
3	26.8	10.5
5	27.1	10.7
10	27.6	10.9
15	28.0	11.0
20	28.2	11.1
25	28.5	11.2
30	28.7	11.3
35	28.8	11.3
40	29.0	11.4
45	29.2	11.5
50	29.3	11.6
55	29.5	11.6
60	29.7	11.7
65	29.9	11.8
70	30.1	11.8
75	30.3	11.9
80	30.5	12.0
85	30.8	12.1
90	31.1	12.3
95	31.6	12.4
97	31.9	12.6
98	32.2	12.7
99	32.5	12.8

FIST CIRCUMFERENCE

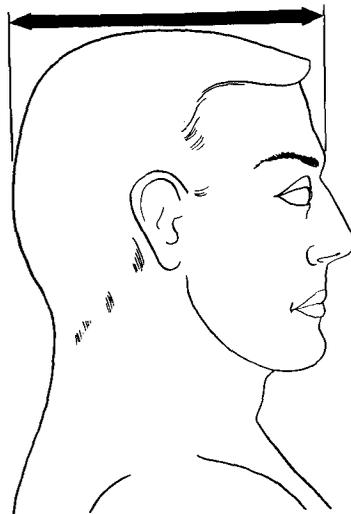
Subject makes a tight fist with his right hand, the thumb lying across the end of the fist. With the tape passing over the thumb and the knuckles (distal ends of the metacarpal bones), measure the circumference of the fist.

Mean: 29.36(.02) cm; 11.56(.01) in.
 Standard Deviation: 1.45(.02) cm; .57(.00) in.
 Range: 18-34 cm; 7.09-13.39 in.
 V = 4.94(.06)% N = 4053

THE HEAD AND FACE

Percentile Values

%	MM	IN.
1	182.0	7.2
2	183.7	7.2
3	184.8	7.3
5	186.3	7.3
10	189.0	7.4
15	190.5	7.5
20	191.8	7.5
25	192.8	7.6
30	193.7	7.6
35	194.5	7.7
40	195.3	7.7
45	196.1	7.7
50	196.9	7.7
55	197.7	7.8
60	198.5	7.8
65	199.6	7.9
70	200.4	7.9
75	201.4	7.9
80	202.6	8.0
85	204.1	8.0
90	205.6	8.1
95	207.5	8.2
97	208.9	8.2
98	210.0	8.3
99	211.6	8.3



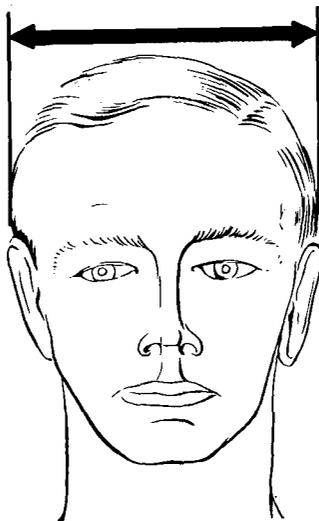
HEAD LENGTH

Holding the spreading caliper near its tips, measure the maximum length of the head from glabella (on the forehead) to the occipital region.

Mean: 197.07(.10) mm; 7.76(.04) in.
 Standard Deviation: 6.43(.07) mm; .25(.00) in.
 Range: 175-223 mm; 6.89-8.78 in.
 V = 3.26(.04)% N = 4063

Percentile Values

%	MM	IN.
1	142.6	5.61
2	143.8	5.66
3	144.5	5.69
5	145.7	5.74
10	147.6	5.81
15	149.0	5.87
20	149.9	5.90
25	150.5	5.93
30	151.1	5.95
35	151.8	5.98
40	152.4	6.00
45	153.1	6.03
50	153.7	6.05
55	154.4	6.08
60	155.1	6.11
65	155.9	6.14
70	156.7	6.17
75	157.7	6.21
80	158.5	6.24
85	159.5	6.28
90	160.7	6.33
95	162.5	6.40
97	163.8	6.45
98	164.9	6.49
99	166.5	6.56



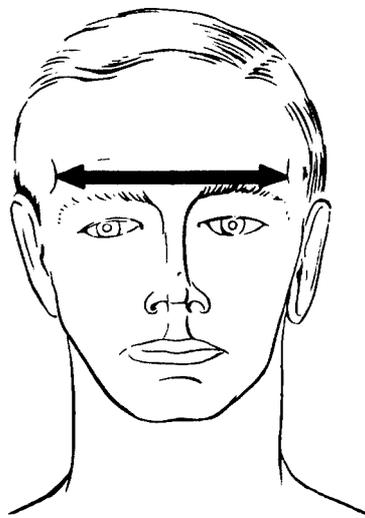
HEAD BREADTH

Holding the spreading caliper near its tips, measure the maximum breadth of the head in a plane perpendicular to the mid-sagittal plane.

Mean: 154.07(.08) mm; 6.07(.00) in.
 Standard Deviation: 5.14(.06) mm; .20(.00) in.
 Range: 136-175 mm; 5.35-6.89 in.
 V = 3.33(.04)% N = 4059

Percentile Values

%	MM	IN.
1	98.6	3.88
2	100.2	3.94
3	101.2	3.98
5	102.6	4.04
10	104.3	4.11
15	105.4	4.15
20	106.4	4.19
25	107.2	4.22
30	108.0	4.25
35	108.8	4.28
40	109.6	4.31
45	110.0	4.33
50	110.4	4.35
55	111.0	4.37
60	111.6	4.39
65	112.3	4.42
70	113.1	4.45
75	113.9	4.49
80	114.8	4.52
85	115.4	4.54
90	116.7	4.59
95	118.8	4.68
97	119.9	4.72
98	120.7	4.75
99	122.0	4.80



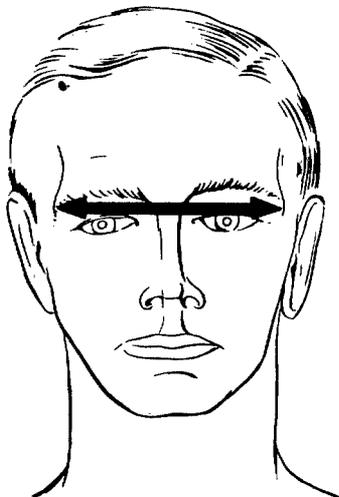
MINIMUM FRONTAL DIAMETER

Holding the spreading caliper near its tips, measure the minimum horizontal diameter across the temporal crests at their points of greatest indentation. Care must be taken that the measurement is made on the crests and not on the temporal muscles.

Mean: 110.53(.08) mm; 4.35(.00) in.
 Standard Deviation: 4.92(.06) mm; .19(.00) in.
 Range: 90-127 mm; 3.54-5.00 in.
 V = 4.45(.05)% N = 4061

Percentile Values

%	MM	IN.
1	108.2	4.26
2	109.7	4.32
3	110.3	4.34
5	111.4	4.39
10	113.5	4.47
15	114.7	4.51
20	115.4	4.54
25	116.2	4.57
30	116.9	4.60
35	117.6	4.63
40	118.4	4.66
45	119.3	4.70
50	119.8	4.72
55	120.2	4.73
60	120.6	4.75
65	121.2	4.77
70	122.0	4.80
75	122.8	4.84
80	123.7	4.87
85	124.8	4.91
90	126.1	4.96
95	128.2	5.05
97	129.5	5.10
98	130.5	5.14
99	132.1	5.20



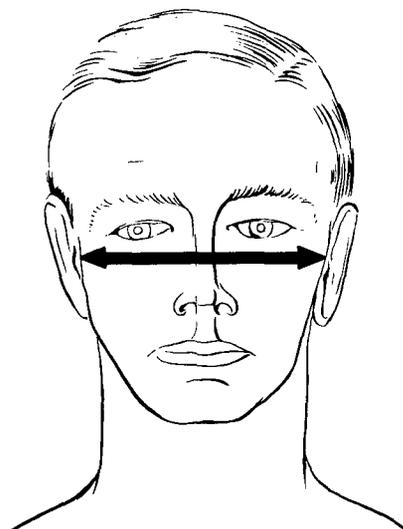
MAXIMUM FRONTAL DIAMETER

Holding the spreading caliper near its tips, measure the horizontal distance between the maximum bulges of the brow ridges, just below the minimum frontal region, at about the ends of the eye brows.

Mean: 119.67(.08) mm; 4.71(.00) in.
 Standard Deviation: 5.03(.06) mm; .20(.00) in.
 Range: 102-139mm; 4.02-5.47 in.
 V = 4.20(.05)% N = 4059

Percentile Values

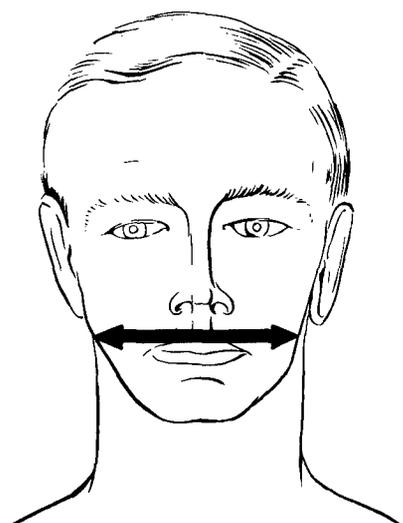
%	MM	IN.
1	128.7	5.07
2	130.2	5.13
3	131.2	5.16
5	132.4	5.21
10	134.3	5.29
15	135.6	5.34
20	136.7	5.38
25	137.5	5.41
30	138.2	5.44
35	138.9	5.47
40	139.5	5.49
45	140.2	5.52
50	140.7	5.54
55	141.3	5.56
60	141.9	5.58
65	142.5	5.61
70	143.2	5.64
75	143.9	5.67
80	144.9	5.70
85	145.8	5.74
90	147.2	5.79
95	149.3	5.88
97	150.5	5.93
98	151.5	5.96
99	153.0	6.02



BIZYGOMATIC DIAMETER

Holding the spreading caliper near its tips, measure the maximum horizontal breadth of the face across the most laterally projecting bones of the cheek (zygomatic arches).

Mean: 140.85(.08) mm; 5.55(.00) in.
 Standard Deviation: 5.10(.06) mm; .20(.00) in.
 Range: 120-158 mm; 4.72-6.22 in.
 V = 3.61(.04)% N = 4061



BIGONIAL DIAMETER

Holding the spreading caliper near its tips and using firm contact, measure the maximum horizontal width of the jaw across the gonial angles.

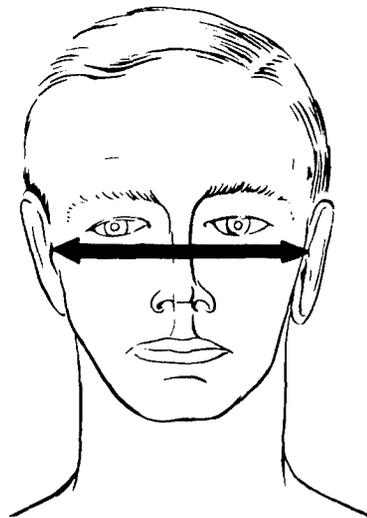
Mean: 108.54(.09) mm; 4.27(.00) in.
 Standard Deviation: 5.55(.06) mm; .22(.00) in.
 Range: 89-129 mm; 3.50-5.08 in.
 V = 5.11(.06)% N = 4060

Percentile Values

%	MM	IN.
1	95.5	3.8
2	97.2	3.8
3	98.6	3.9
5	99.9	3.9
10	101.5	4.0
15	102.8	4.0
20	103.9	4.1
25	104.8	4.1
30	105.4	4.1
35	106.3	4.2
40	107.1	4.2
45	107.9	4.2
50	108.7	4.3
55	109.5	4.3
60	110.0	4.3
65	110.4	4.3
70	111.2	4.4
75	112.2	4.4
80	113.1	4.5
85	114.3	4.5
90	115.4	4.5
95	117.7	4.6
97	119.4	4.7
98	120.6	4.7
99	122.6	4.8

Percentile Values

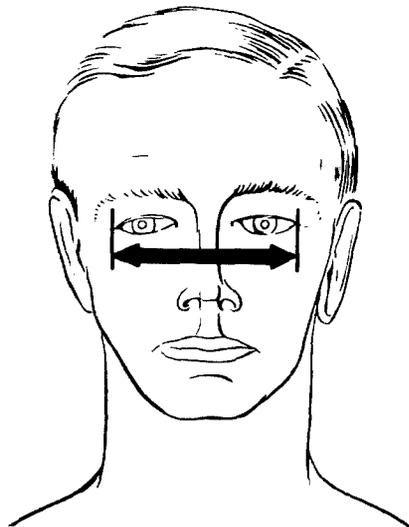
%	MM	IN.
1	129.3	5.1
2	131.2	5.2
3	132.3	5.2
5	133.6	5.3
10	135.6	5.3
15	136.8	5.4
20	138.0	5.4
25	138.9	5.5
30	139.6	5.5
35	140.4	5.5
40	141.0	5.5
45	141.6	5.6
50	142.2	5.6
55	142.8	5.6
60	143.4	5.6
65	144.1	5.7
70	144.8	5.7
75	145.6	5.7
80	146.5	5.8
85	147.6	5.8
90	149.0	5.9
95	151.0	5.9
97	152.4	6.0
98	153.4	6.0
99	154.8	6.1



BITRAGION DIAMETER

Holding the spreading caliper near its tips, measure the diameter from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 142.17(.08) mm; 5.60(.00) in.
 Standard Deviation: 5.33(.06) mm; .21(.00) in.
 Range: 121-160 mm; 4.76-6.30 in.
 V = 3.62(.04)% N = 4060



BIOCULAR DIAMETER

With the bar of the sliding caliper resting lightly on the subject's face, measure the distance between the outer corners of the eyes (external canthi).

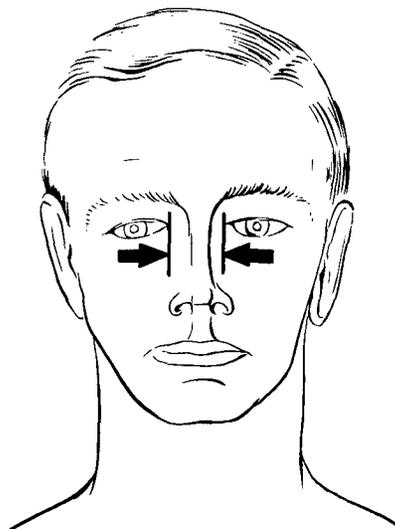
Mean: 95.89(.07) mm; 3.78(.00) in.
 Standard Deviation: 4.42(.05) mm; .17(.00) in.
 Range: 81-113 mm; 3.19-4.45 in.
 V = 4.61(.05)% N = 4061

Percentile Values

%	MM	IN.
1	85.9	3.38
2	87.0	3.43
3	87.6	3.45
5	88.5	3.48
10	90.0	3.54
15	91.2	3.59
20	92.1	3.62
25	92.9	3.66
30	93.6	3.69
35	94.2	3.71
40	94.8	3.73
45	95.3	3.75
50	95.9	3.78
55	96.5	3.80
60	97.1	3.82
65	97.7	3.85
70	98.5	3.88
75	98.9	3.90
80	99.4	3.91
85	100.4	3.95
90	101.5	3.99
95	103.1	4.06
97	104.3	4.11
98	105.1	4.14
99	106.5	4.19

Percentile Values

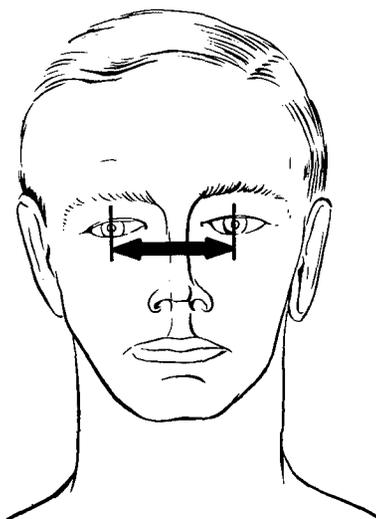
<u>%</u>	<u>MM</u>	<u>IN.</u>
1	26.2	1.03
2	26.8	1.06
3	27.2	1.07
5	27.8	1.09
10	28.6	1.13
15	29.1	1.14
20	29.5	1.16
25	29.9	1.18
30	30.3	1.19
35	30.6	1.21
40	31.0	1.22
45	31.3	1.23
50	31.6	1.25
55	32.0	1.26
60	32.3	1.27
65	32.6	1.28
70	33.0	1.30
75	33.5	1.32
80	33.9	1.34
85	34.4	1.35
90	35.1	1.38
95	36.1	1.42
97	36.8	1.45
98	37.3	1.47
99	38.1	1.50



INTEROCULAR DIAMETER

With the bar of the sliding caliper resting lightly on the subject's face, measure the distance between the inner corners of the eyes (internal canthi).

Mean: 31.73(.04) mm; 1.25(.00) in.
 Standard Deviation: 2.56(.03) mm; .10(.00) in.
 Range: 22-42 mm; .87-1.65 in.
 V = 8.07(.09)% N = 4055



INTERPUPILLARY DISTANCE

Measure the distance between the subject's pupil centers. To do this, instruct him to look at whichever eye you hold open. Rest the sliding caliper lightly on his face, close your right eye, and center the fixed tip before his right eye. Now open your right eye, close your left one, and center the sliding tip before his left eye. Do not allow his head, your head, or the caliper to move during the measuring.

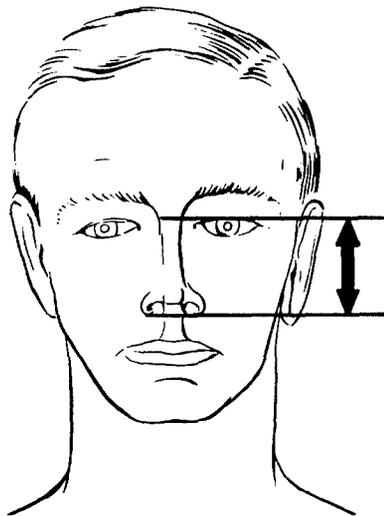
Mean: 63.27(.06) mm; 2.49(.00) in.
 Standard Deviation: 3.64(.04) mm; .14(.00) in.
 Range: 51-76 mm; 2.01-2.99 in.
 V = 5.75(.06)% N = 4057

Percentile Values

<u>%</u>	<u>MM</u>	<u>IN.</u>
1	55.5	2.19
2	56.3	2.22
3	56.9	2.24
5	57.6	2.27
10	58.8	2.31
15	59.4	2.34
20	60.0	2.36
25	60.6	2.39
30	61.2	2.41
35	61.7	2.43
40	62.2	2.45
45	62.7	2.47
50	63.2	2.49
55	63.7	2.51
60	64.1	2.52
65	64.5	2.54
70	65.1	2.56
75	65.6	2.58
80	66.3	2.61
85	67.2	2.64
90	68.2	2.68
95	69.5	2.74
97	70.4	2.77
98	71.0	2.80
99	72.1	2.84

Percentile Values

%	MM	IN.
1	43.0	1.69
2	43.9	1.73
3	44.5	1.75
5	45.4	1.79
10	46.6	1.83
15	47.4	1.87
20	48.2	1.90
25	48.7	1.92
30	49.1	1.93
35	49.4	1.94
40	49.8	1.96
45	50.3	1.98
50	50.8	2.00
55	51.3	2.02
60	51.8	2.04
65	52.3	2.06
70	52.8	2.08
75	53.4	2.10
80	53.9	2.12
85	54.4	2.14
90	55.3	2.18
95	56.6	2.23
97	57.5	2.26
98	58.1	2.29
99	59.1	2.33



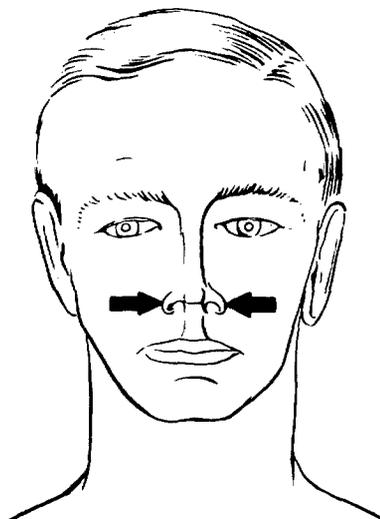
NOSE LENGTH

Using the sliding caliper, measure the distance from the mid-point of the nasal root to the bottom of the nose (subnasale).

Mean: 50.93(.05) mm; 2.01(.00) in.
 Standard Deviation: 3.46(.04) mm; .14(.00) in.
 Range: 37-65 mm; 1.46-2.56 in.
 V = 6.79(.08)% N = 4061

Percentile Values

%	MM	IN.
1	27.6	1.09
2	28.5	1.12
3	28.9	1.14
5	29.4	1.16
10	30.0	1.18
15	30.6	1.21
20	31.1	1.22
25	31.6	1.24
30	31.9	1.26
35	32.3	1.27
40	32.7	1.29
45	33.0	1.30
50	33.4	1.31
55	33.7	1.33
60	34.0	1.34
65	34.3	1.35
70	34.6	1.36
75	35.0	1.38
80	35.5	1.40
85	36.0	1.42
90	36.7	1.45
95	37.8	1.49
97	38.7	1.52
98	39.2	1.54
99	40.2	1.58



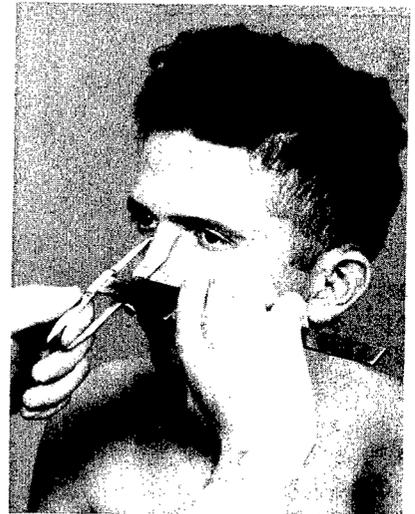
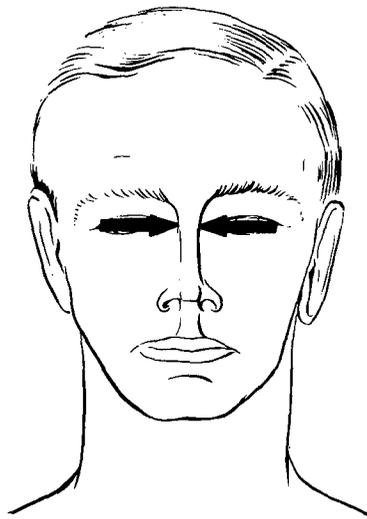
NOSE BREADTH

Using the sliding caliper, measure the maximum breadth of the nose.

Mean: 33.38(.04) mm; 1.31(.00) in.
 Standard Deviation: 2.67(.03) mm; .11(.00) in.
 Range: 23-47 mm; .91-1.85 in.
 V = 8.00(.09)% N = 4058

Percentile Values

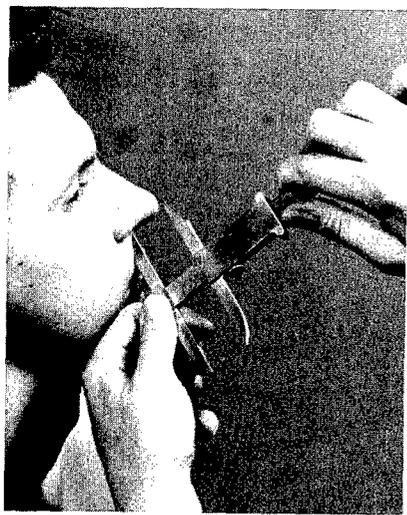
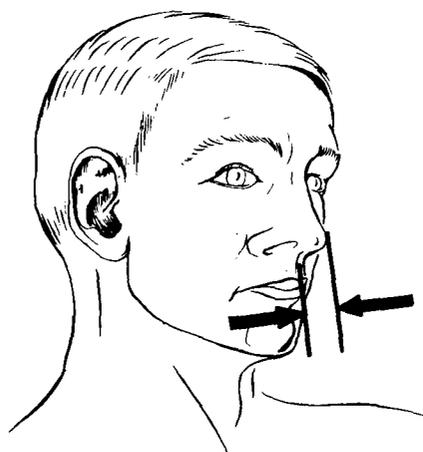
%	MM	IN.
1	10.6	.42
2	11.2	.44
3	11.6	.46
5	12.1	.48
10	12.8	.51
15	13.3	.52
20	13.8	.54
25	14.1	.56
30	14.4	.57
35	14.7	.58
40	14.9	.59
45	15.2	.60
50	15.4	.61
55	15.7	.62
60	15.9	.63
65	16.2	.64
70	16.5	.65
75	16.8	.66
80	17.2	.68
85	17.6	.69
90	18.1	.71
95	18.9	.74
97	19.5	.77
98	19.9	.78
99	20.5	.81



NASAL ROOT BREADTH

Using the sliding caliper, measure the breadth of the nasal root.

Mean: 15.55(.03) mm; .61(.00) in.
 Standard Deviation: 2.13(.02) mm; .08(.00) in.
 Range: 7-23 mm; .28-.91 in.
 V = 13.69(.15)% N = 4054



NOSE PROTRUSION

With the fixed arm of the sliding caliper resting in the philtrum, measure the distance from the base of the septum to the maximum forward protrusion of the nose.

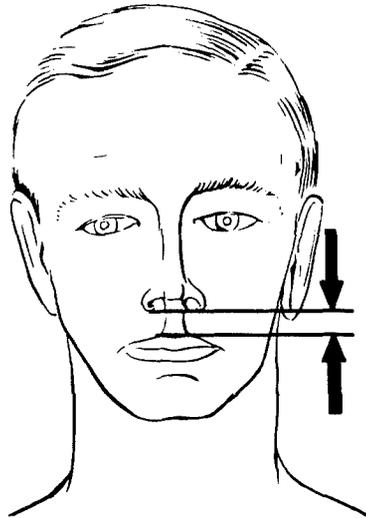
Mean: 22.71(.05) mm; .89(.00) in.
 Standard Deviation: 2.88(.04) mm; .11(.00) in.
 Range: 11-36 mm; .43-1.42 in.
 V = 12.68(.14)% N = 4063

Percentile Values

%	MM	IN.
1	16.1	.63
2	17.0	.67
3	17.6	.69
5	18.4	.72
10	19.0	.75
15	19.6	.77
20	20.2	.79
25	20.7	.82
30	21.1	.83
35	21.6	.85
40	22.0	.86
45	22.4	.88
50	22.7	.90
55	23.1	.91
60	23.5	.93
65	23.8	.94
70	24.2	.95
75	24.5	.96
80	25.0	.98
85	25.6	1.01
90	26.3	1.04
95	27.4	1.08
97	28.1	1.11
98	28.7	1.13
99	29.7	1.17

Percentile Values

%	MM	IN.
1	12.1	.48
2	12.8	.50
3	13.2	.52
5	13.8	.54
10	14.8	.58
15	15.6	.62
20	16.4	.64
25	17.0	.67
30	17.7	.70
35	18.2	.72
40	18.7	.74
45	19.0	.75
50	19.3	.76
55	19.9	.78
60	20.4	.80
65	20.9	.82
70	21.4	.84
75	21.9	.86
80	22.5	.88
85	23.1	.91
90	23.9	.94
95	25.0	.98
97	26.0	1.02
98	26.6	1.05
99	27.7	1.09



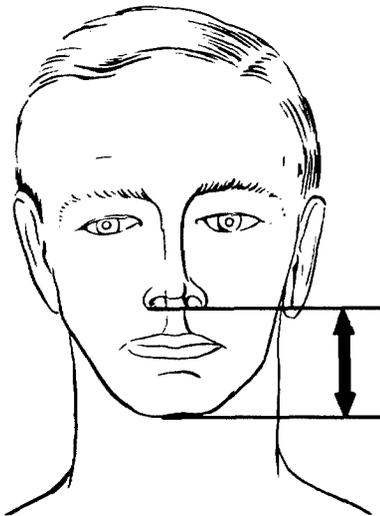
PHILTRUM LENGTH

Subject's facial muscles are relaxed and his jaws are closed. Using the sliding caliper, measure the height of the groove (philtrum) which runs vertically from the upper edge of the (membranous) lip to the bottom of the nose (subnasale).

Mean: 19.47(.05) mm; .77(.00) in.
 Standard Deviation: 3.49(.04) mm; .14(.00) in.
 Range: 9-37 mm; .35-1.46 in.
 V = 17.92(.21)% N = 4063

Percentile Values

%	MM	IN.
1	52.0	2.05
2	53.4	2.10
3	54.3	2.14
5	55.6	2.19
10	57.8	2.28
15	59.2	2.33
20	60.5	2.38
25	61.7	2.43
30	62.9	2.48
35	63.9	2.52
40	64.7	2.55
45	65.5	2.58
50	66.6	2.62
55	67.4	2.65
60	68.5	2.70
65	69.3	2.73
70	70.4	2.77
75	71.5	2.81
80	72.7	2.86
85	74.0	2.91
90	75.8	2.98
95	78.1	3.07
97	79.7	3.13
98	81.1	3.19
99	83.4	3.28



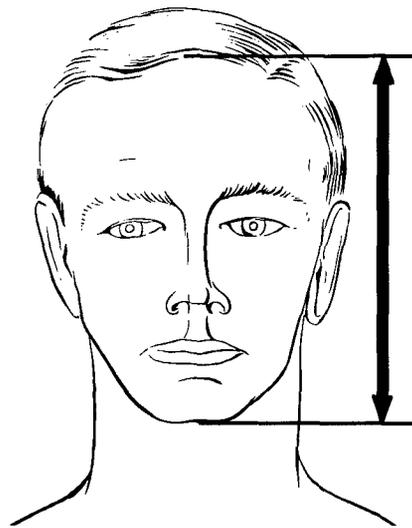
MENTON-SUBNASALE LENGTH

Subject's facial muscles are relaxed and his jaws are closed. Using the sliding caliper, measure vertically from the tip at the bottom surface of the chin (menton) to the bottom of the nose (subnasale).

Mean: 66.69(.11) mm; 2.63(.00) in.
 Standard Deviation: 6.91(.08) mm; .27(.00) in.
 Range: 46-90 mm; 1.81-3.54 in.
 V = 10.36(.12)% N = 4062

Percentile Values

%	MM	IN.
1	166.5	6.6
2	168.7	6.6
3	170.2	6.7
5	172.2	6.8
10	175.3	6.9
15	177.6	7.0
20	179.2	7.1
25	180.8	7.1
30	182.2	7.2
35	183.4	7.2
40	184.6	7.3
45	185.8	7.3
50	187.0	7.4
55	188.4	7.4
60	189.3	7.4
65	190.3	7.5
70	191.6	7.5
75	193.1	7.6
80	194.6	7.7
85	196.2	7.7
90	198.9	7.8
95	202.1	8.0
97	204.2	8.0
98	205.8	8.1
99	208.9	8.2



MENTON-CRINION LENGTH

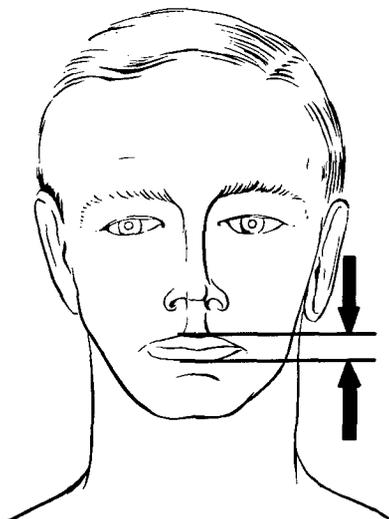
Subject's facial muscles are relaxed and his jaws are closed. Using the sliding caliper, measure vertically from the tip at the bottom surface of the chin (menton) to the midpoint of the hair line (crinion). If there is evidence of balding, this measurement is omitted.

Mean: 187.01(.15) mm; 7.36(.01) in.

Standard Deviation: 9.05(.11) mm; .36(.00) in.

Range: 157-218 mm; 6.18-8.58 in.

V = 4.84(.06)% N = 3555



LIP-TO-LIP DISTANCE

Subject's facial muscles are relaxed and his jaws are closed. Using the sliding caliper, measure the maximum distance between the lower margin of the lower lip and the upper margin of the upper lip.

Mean: 16.19(.05) mm; .64(.00) in.

Standard Deviation: 3.14(.04) mm; .12(.00) in.

Range: 4-32 mm; .16-1.26 in.

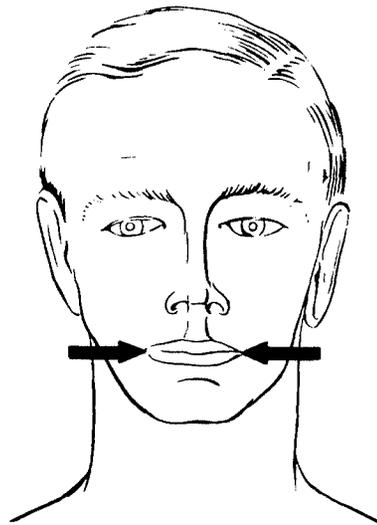
V = 19.39(.02)% N = 4059

Percentile Values

%	MM	IN.
1	8.8	.35
2	9.7	.38
3	10.3	.41
5	11.1	.44
10	12.2	.48
15	13.1	.51
20	13.7	.54
25	14.1	.56
30	14.5	.57
35	14.9	.59
40	15.3	.60
45	15.7	.62
50	16.1	.63
55	16.5	.65
60	16.9	.67
65	17.4	.68
70	17.8	.70
75	18.4	.72
80	18.9	.74
85	19.3	.76
90	20.1	.79
95	21.2	.83
97	22.0	.87
98	22.6	.89
99	23.9	.94

Percentile Values

%	MM	IN.
1	43.7	1.72
2	44.6	1.76
3	45.1	1.78
5	46.0	1.81
10	47.3	1.86
15	48.2	1.90
20	48.7	1.92
25	49.1	1.93
30	49.5	1.95
35	49.9	1.97
40	50.4	1.98
45	50.9	2.00
50	51.4	2.02
55	51.9	2.04
60	52.4	2.06
65	53.0	2.08
70	53.5	2.11
75	54.0	2.12
80	54.4	2.14
85	55.2	2.17
90	56.2	2.21
95	57.7	2.27
97	58.6	2.31
98	59.3	2.33
99	60.4	2.38



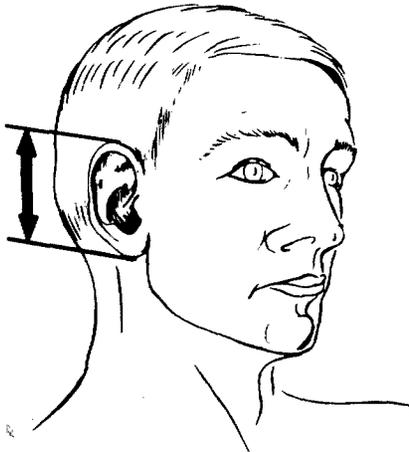
LIP LENGTH (BICHELION DIAMETER)

Subject's facial muscles are relaxed and his jaws are closed. Using the sliding caliper, measure the maximum distance between the corners of the mouth.

Mean: 51.58(.06) mm; 2.03(.00) in.
 Standard Deviation: 3.59(.04) mm; .14(.00) in.
 Range: 34-67 mm; 1.34-2.64 in.
 V = 6.96(.08)% N = 4062

Percentile Values

%	MM	IN.
1	52.9	2.08
2	54.2	2.13
3	55.0	2.17
5	56.1	2.21
10	57.6	2.27
15	58.7	2.31
20	59.2	2.33
25	59.9	2.36
30	60.5	2.38
35	61.0	2.40
40	61.6	2.42
45	62.1	2.45
50	62.7	2.47
55	63.3	2.49
60	63.8	2.51
65	64.2	2.53
70	64.6	2.54
75	65.3	2.57
80	66.0	2.60
85	66.8	2.63
90	68.0	2.68
95	69.3	2.73
97	70.3	2.77
98	71.2	2.80
99	72.5	2.85



EAR LENGTH

Using the sliding caliper, measure the maximum length of the subject's right ear along its long axis.

Mean: 62.67(.06) mm; 2.47(.00) in.
 Standard Deviation: 4.09(.04) mm; .16(.00) in.
 Range: 43-80 mm; 1.69-3.15 in.
 V = 6.53(.07)% N = 4062

Percentile Values

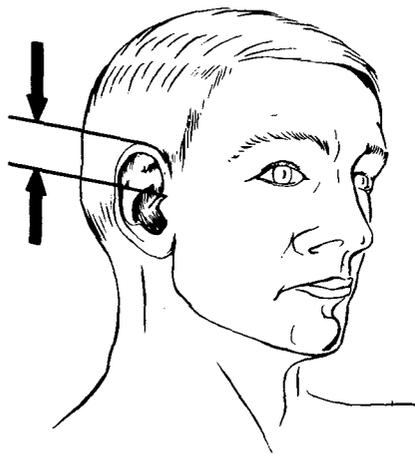
%	MM	IN.
1	30.5	1.20
2	31.2	1.23
3	31.6	1.24
5	32.3	1.27
10	33.2	1.31
15	33.8	1.33
20	34.2	1.35
25	34.7	1.37
30	35.1	1.38
35	35.5	1.40
40	35.8	1.41
45	36.2	1.42
50	36.5	1.44
55	36.9	1.45
60	37.2	1.47
65	37.6	1.48
70	38.2	1.50
75	38.6	1.52
80	39.0	1.53
85	39.3	1.55
90	39.9	1.57
95	40.9	1.61
97	41.7	1.64
98	42.3	1.67
99	43.1	1.70



EAR BREADTH

With the fixed arm of the sliding caliper parallel to the long axis of the ear, measure the maximum breadth of the ear.

Mean: 36.59(.04) mm; 1.44(.00) in.
 Standard Deviation: 2.71(.03) mm; .11(.00) in.
 Range: 28-49 mm; 1.10-1.93 in.
 V = 7.41(.08)% N = 4060



EAR LENGTH ABOVE TRAGION

With the bar of the sliding caliper held parallel to the long axis of the right ear, and one caliper arm passing over tragon, measure the distance to the top of the ear.

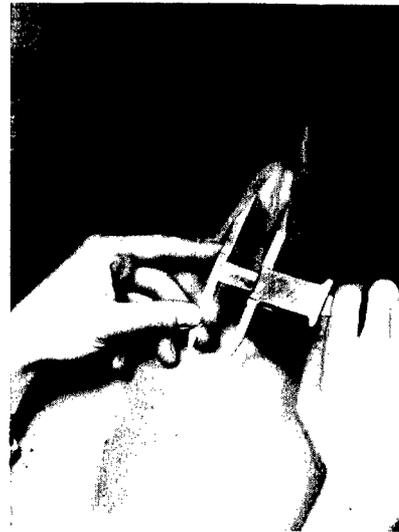
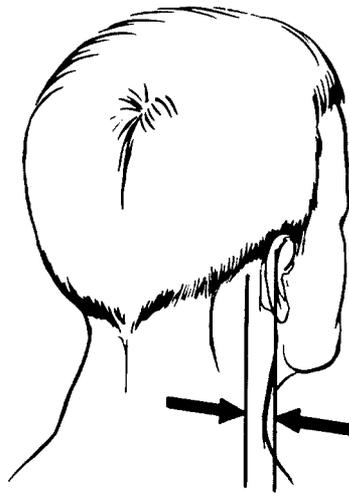
Mean: 29.71(.04) mm; 1.17(.00) in.
 Standard Deviation: 2.78(.03) mm; .11(.00) in.
 Range: 20-41 mm; .79-1.61 in.
 V = 9.36(.10)% N = 4061

Percentile Values

%	MM	IN.
1	23.4	.92
2	24.0	.94
3	24.5	.96
5	25.1	.99
10	26.0	1.02
15	26.8	1.05
20	27.4	1.08
25	27.9	1.10
30	28.4	1.12
35	28.7	1.13
40	29.0	1.14
45	29.3	1.15
50	29.6	1.17
55	30.0	1.18
60	30.4	1.20
65	30.8	1.21
70	31.2	1.23
75	31.6	1.24
80	32.1	1.26
85	32.6	1.28
90	33.4	1.31
95	34.2	1.35
97	34.8	1.37
98	35.3	1.39
99	36.1	1.42

Percentile Values

%	MM	IN.
1	14.0	.55
2	14.8	.58
3	15.3	.60
5	15.9	.63
10	17.0	.69
15	17.9	.70
20	18.6	.73
25	18.9	.75
30	19.3	.76
35	19.8	.78
40	20.2	.80
45	20.7	.82
50	21.2	.83
55	21.6	.85
60	22.1	.87
65	22.6	.89
70	23.2	.91
75	23.8	.94
80	24.4	.96
85	25.1	.99
90	26.2	1.03
95	27.9	1.10
97	29.0	1.14
98	29.8	1.17
99	31.3	1.23



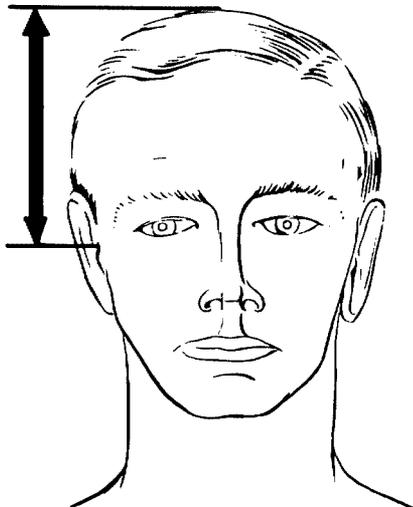
EAR PROTRUSION

With the fixed point of the sliding caliper resting on the right mastoid process (the bony eminence directly behind the ear), measure the distance to the most lateral protrusion of the ear.

Mean: 21.45(.06) mm; .84(.00) in.
 Standard Deviation: 3.66(.04) mm; .14(.00) in.
 Range: 8-39 mm; .31-1.54 in.
 V = 17.06(.20)% N = 4063

Percentile Values

%	MM	IN.
1	111.8	4.4
2	113.8	4.5
3	115.0	4.5
5	116.8	4.6
10	120.0	4.7
15	122.0	4.8
20	123.2	4.9
25	124.5	4.9
30	125.8	5.0
35	126.9	5.0
40	127.9	5.0
45	128.8	5.1
50	129.9	5.1
55	130.8	5.2
60	131.9	5.2
65	132.7	5.2
70	133.7	5.3
75	134.7	5.3
80	136.0	5.4
85	137.6	5.4
90	138.9	5.5
95	141.8	5.6
97	143.6	5.7
98	145.0	5.7
99	147.3	5.8



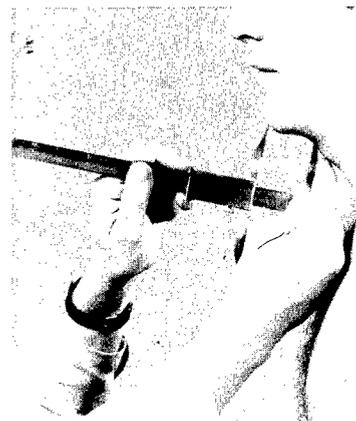
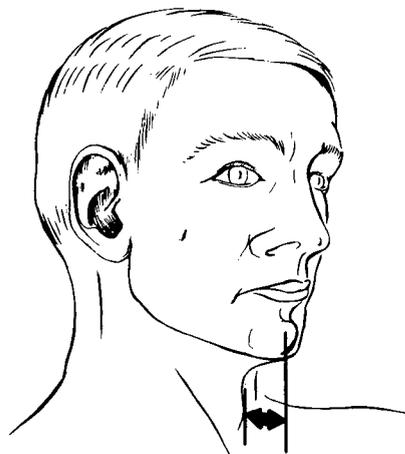
HEAD HEIGHT (TRAGION TO VERTEX)

Subject holds his head in the Frankfort plane but turns it slightly to the left to clear the anthropometer. Measure the vertical distance from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the highest point of the head with the instrument arm firmly touching the scalp.

Mean: 129.68(.12) mm; 5.11(.00) in.
 Standard Deviation: 7.65(.09) mm; .30(.00) in.
 Range: 100-159 mm; 3.90-6.26 in.
 V = 5.90(.06)% N = 4061

Percentile Values

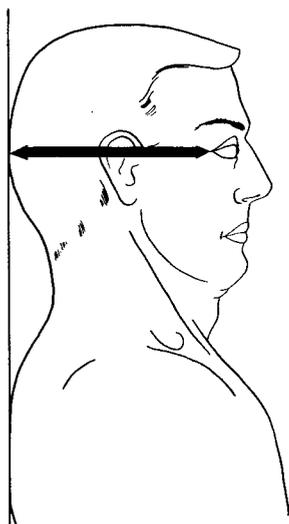
%	MM	IN.
1	32.6	1.3
2	34.4	1.4
3	35.3	1.4
5	37.1	1.5
10	39.2	1.5
15	40.8	1.6
20	42.1	1.7
25	43.3	1.7
30	44.2	1.7
35	45.0	1.8
40	45.9	1.8
45	46.8	1.8
50	47.6	1.9
55	48.5	1.9
60	49.1	1.9
65	49.9	2.0
70	50.9	2.0
75	52.0	2.0
80	53.3	2.1
85	54.5	2.1
90	56.2	2.2
95	58.7	2.3
97	60.1	2.4
98	61.7	2.4
99	63.8	2.5



MENTON PROJECTION

Subject sits, looking forward (head oriented in the Frankfort plane). With the sliding caliper held approximately horizontal, measure the distance from the most forward point of the chin to the juncture of the neck and the bottom of the jaw.

Mean: 47.66(.10) mm; 1.88(.00) in.
 Standard Deviation: 6.60(.07) mm; .26(.00) in.
 Range: 25-72 mm; .98-2.83 in.
 V = 13.85(.15)% N = 4063



Percentile Values

%	MM	IN.
1	152.0	6.0
2	155.0	6.1
3	156.7	6.2
5	158.7	6.2
10	162.0	6.4
15	163.9	6.5
20	165.4	6.5
25	166.9	6.6
30	168.1	6.6
35	169.3	6.7
40	170.3	6.7
45	171.3	6.7
50	172.3	6.8
55	173.2	6.8
60	174.2	6.9
65	175.1	6.9
70	176.2	6.9
75	177.5	7.0
80	178.7	7.0
85	180.3	7.1
90	182.1	7.2
95	184.9	7.3
97	186.6	7.3
98	188.4	7.4
99	189.9	7.5

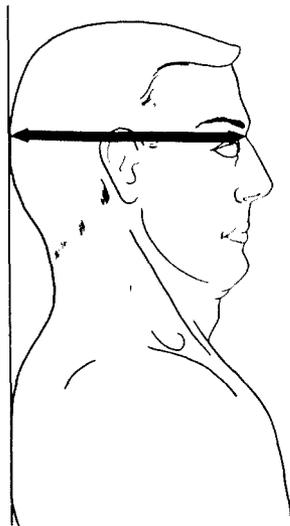
EXTERNAL CANTHUS TO WALL

Subject stands erect, looking directly forward (head oriented in the Frankfort plane), both shoulders and the back of his head touching a wall. Using the anthropometer, measure the horizontal distance from the wall to the outer corner (external canthus) of the right eye.

Mean: 172.09(.13) mm; 6.78(.01) in.
 Standard Deviation: 8.04(.09) mm; .32(.00) in.
 Range: 140-201 mm; 5.51-7.91 in.
 V = 4.67(.05)% N = 4062

Percentile Values

%	MM	IN.
1	176.9	7.0
2	179.4	7.1
3	180.5	7.1
5	182.8	7.2
10	185.8	7.3
15	188.0	7.4
20	189.5	7.7
25	190.8	7.5
30	192.3	7.6
35	193.4	7.6
40	194.6	7.7
45	195.7	7.7
50	197.0	7.8
55	198.1	7.8
60	199.1	7.8
65	200.2	7.9
70	201.5	7.9
75	202.8	8.0
80	204.2	8.0
85	205.8	8.1
90	208.2	8.2
95	211.1	8.3
97	213.0	8.4
98	214.5	8.4
99	216.9	8.5



NASAL ROOT TO WALL

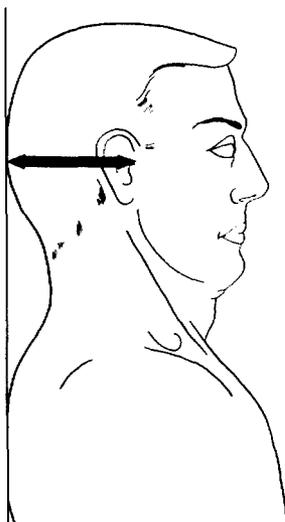
Subject stands erect, looking directly forward (head oriented in the Frankfort plane), both shoulders and the back of his head touching a wall. Using the anthropometer, measure the horizontal distance from the wall to the point of greatest indentation where the nose meets the forehead (nasal root).

Mean: 196.88(.14) mm; 7.75(.01) in.

Standard Deviation: 8.66(.10) mm; .34(.00) in.

Range: 166-229 mm; 6.54-9.02 in.

V = 4.40(.05)% N = 4063



TRAGION TO WALL

Percentile Values

%	MM	IN.
1	85.4	3.4
2	87.5	3.4
3	88.4	3.5
5	90.0	3.5
10	92.7	3.6
15	94.5	3.7
20	95.9	3.8
25	97.3	3.8
30	98.3	3.9
35	99.5	3.9
40	100.4	3.9
45	101.3	4.0
50	102.4	4.0
55	103.3	4.1
60	104.3	4.1
65	105.1	4.1
70	106.1	4.2
75	107.3	4.2
80	108.4	4.3
85	109.9	4.3
90	111.8	4.4
95	114.7	4.5
97	116.5	4.6
98	118.3	4.7
99	121.0	4.8

Subject stands erect, looking directly forward (head oriented in the Frankfort plane), both shoulders and the back of his head touching a wall. Using the anthropometer, measure the horizontal distance from the wall to the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole.

Mean: 102.31(.12) mm; 4.03(.00) in.

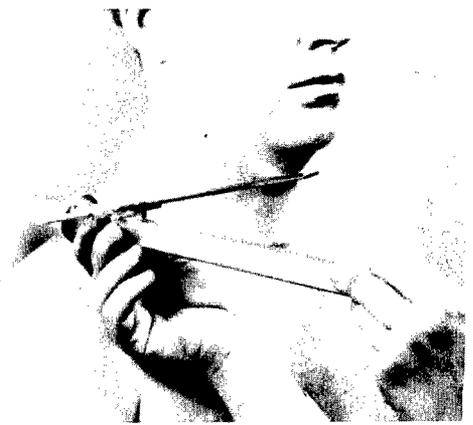
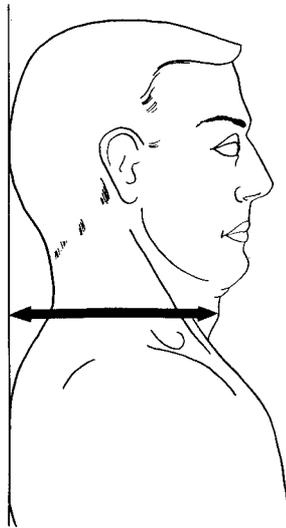
Standard Deviation: 7.59(.09) mm; .30(.00) in.

Range: 78-132 mm; 3.07-5.20 in.

V = 7.42(.08)% N = 4063

Percentile Values

%	MM	IN.
1	147.9	5.8
2	151.4	6.0
3	153.5	6.0
5	156.6	6.2
10	161.1	6.3
15	164.4	6.5
20	166.6	6.6
25	168.7	6.6
30	170.4	6.7
35	172.0	6.8
40	173.5	6.8
45	174.9	6.9
50	176.5	6.9
55	178.0	7.0
60	179.6	7.1
65	181.1	7.1
70	182.9	7.2
75	184.6	7.3
80	186.7	7.3
85	188.9	7.4
90	191.7	7.5
95	195.3	7.7
97	198.0	7.8
98	200.4	7.9
99	203.7	8.0



LARYNX TO WALL

Subject stands erect, looking directly forward (head oriented in the Frankfort plane), both shoulders and the back of his head touching a wall. Using the anthropometer, measure the horizontal distance from the wall to the most forward portion of the "Adam's Apple".

Mean: 176.48(.19) mm; 6.95(.01) in.
 Standard Deviation: 11.88(.13) mm; .47(.01) in.
 Range: 136-219 mm; 5.35-8.62 in.
 V = 6.73(.07)% N = 4062



HEAD CIRCUMFERENCE

Subject sits. With the tape passing above (but not including) the brow ridges, measure the maximum circumference of the head.

Mean: 57.07 (.02) cm; 22.47(.01) in.
 Standard Deviation: 1.58(.01) cm; .62(.00) in.
 Range: 51-62 cm; 20.08-24.41 in.
 V = 2.77(.03)% N = 4056

Percentile Values

%	CM	IN.
1	53.4	21.0
2	53.9	21.2
3	54.2	21.3
5	54.5	21.5
10	55.1	21.7
15	55.4	21.8
20	55.8	22.0
25	56.1	22.1
30	56.3	22.2
35	56.5	22.2
40	56.7	22.3
45	56.9	22.4
50	57.1	22.5
55	57.3	22.6
60	57.5	22.6
65	57.7	22.7
70	57.9	22.8
75	58.2	22.9
80	58.5	23.0
85	58.8	23.2
90	59.2	23.3
95	59.6	23.5
97	60.0	23.6
98	60.3	23.7
99	61.7	24.3

Percentile Values

%	CM	IN.
1	34.5	13.6
2	35.1	13.8
3	35.5	14.0
5	35.9	14.1
10	36.3	14.3
15	36.7	14.5
20	37.1	14.6
25	37.3	14.7
30	37.5	14.8
35	37.7	14.9
40	37.9	14.9
45	38.1	15.0
50	38.3	15.1
55	38.5	15.2
60	38.7	15.3
65	38.9	15.3
70	39.2	15.4
75	39.4	15.5
80	39.7	15.6
85	39.9	15.7
90	40.3	15.9
95	40.7	16.0
97	41.1	16.2
98	41.4	16.3
99	41.8	16.5



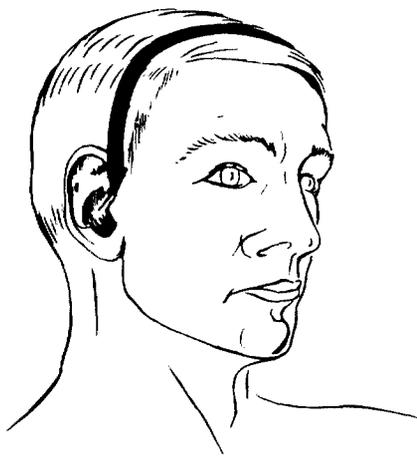
SAGITTAL ARC

Subject sits looking directly forward (head oriented in the Frankfort plane). Holding the tape in the midsagittal plane, measure the arc from glabella on the forehead to the lowest point of the skull which can be felt with a finger among the neck muscles (this point may be at inion or below it).

Mean: 38.27(.021 cm; 15.07(.01) in.
 Standard Deviation: 1.56(.01) cm; .61(.00) in.
 Range: 29-43 cm; 11.42-16.93 in.
 V = 4.08(.05)% N = 4063

Percentile Values

%	CM	IN.
1	32.3	12.7
2	32.6	12.8
3	32.8	12.9
5	33.1	13.0
10	33.6	13.2
15	33.9	13.3
20	34.1	13.4
25	34.4	13.6
30	34.5	13.6
35	34.7	13.6
40	34.9	13.7
45	35.0	13.8
50	35.2	13.8
55	35.3	13.9
60	35.4	13.9
65	35.6	14.0
70	35.7	14.1
75	35.9	14.1
80	36.1	14.2
85	36.4	14.3
90	36.8	14.5
95	37.3	14.7
97	37.7	14.8
98	37.9	14.9
99	38.4	15.1



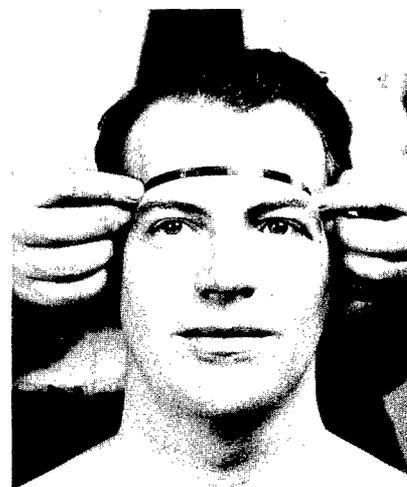
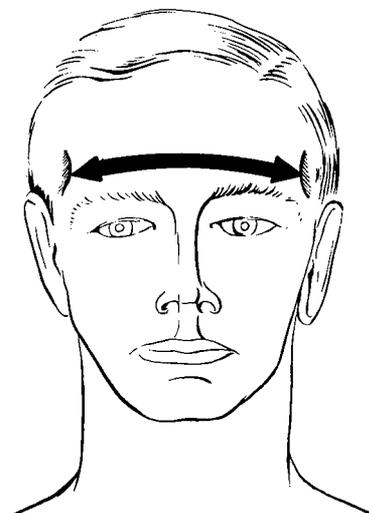
BITRAGION-CORONAL ARC

Subject sits looking directly forward (head oriented in the Frankfort plane). With the tape passing over the top of the head, measure the arc from the cartilaginous notch (tragon) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 35.14(.02) cm; 13.83(.01) in.
 Standard Deviation: 1.29(.01) cm; .51(.00) in.
 Range: 30-39 cm; 11.81-15.35 in.
 V = 3.67(.04)% N = 4059

Percentile Values

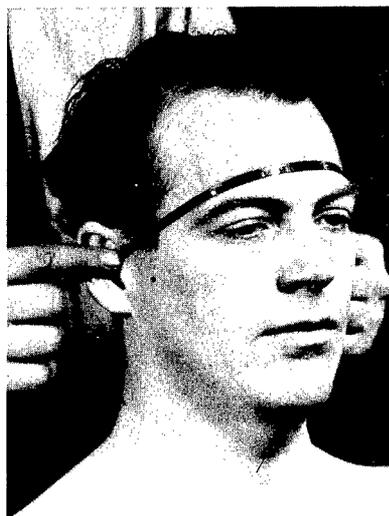
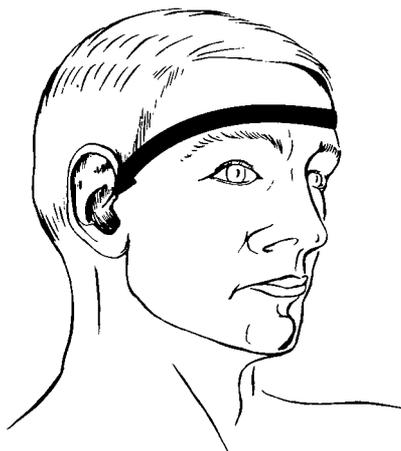
%	CM	IN.
1	11.5	4.5
2	11.8	4.6
3	12.0	4.7
5	12.2	4.8
10	12.6	5.0
15	12.8	5.0
20	13.0	5.1
25	13.1	5.2
30	13.3	5.2
35	13.4	5.3
40	13.6	5.3
45	13.7	5.4
50	13.8	5.4
55	13.9	5.5
60	14.0	5.5
65	14.2	5.6
70	14.3	5.6
75	14.5	5.7
80	14.6	5.8
85	14.8	5.8
90	15.0	5.9
95	15.4	6.1
97	15.6	6.1
98	15.8	6.2
99	16.1	6.3



MINIMUM FRONTAL ARC

Subject sits. With the tape passing between the points of greatest indentation of the temporal crests, measure the arc across the forehead.

Mean: 13.83(.02) cm; 5.44(.01) in.
 Standard Deviation: 1.01(.01) cm; .40(.00) in.
 Range: 10-17 cm; 3.94-6.69 in.
 V = 7.30(.08)% N = 4049



BITRACION-MINIMUM FRONTAL ARC

Subject sits. With the tape passing over the region of the minimum frontal arc, measure the arc from the cartilaginous notch (tracion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

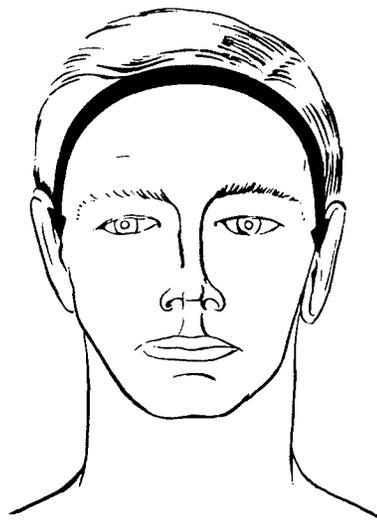
Mean: 30.61(.02) cm; 12.05(.01) in.
 Standard Deviation: 1.12(.01) cm; .44(.00) in.
 Range: 25-39 cm; 9.84-15.35 in.
 V = 3.66(.04)% N = 4055

Percentile Values

%	CM	IN.
1	28.2	11.1
2	28.5	11.2
3	28.7	11.3
5	28.9	11.4
10	29.3	11.5
15	29.5	11.6
20	29.7	11.7
25	29.9	11.8
30	30.0	11.8
35	30.2	11.9
40	30.3	11.9
45	30.4	12.0
50	30.5	12.0
55	30.7	12.1
60	30.8	12.1
65	31.0	12.2
70	31.1	12.2
75	31.3	12.3
80	31.5	12.4
85	31.7	12.5
90	32.0	12.6
95	32.4	12.8
97	32.7	12.9
98	32.9	13.0
99	33.3	13.1

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	30.5	12.0
2	30.7	12.1
3	30.9	12.2
5	31.2	12.3
10	31.6	12.5
15	31.9	12.6
20	32.2	12.7
25	32.4	12.7
30	32.6	12.8
35	32.7	12.9
40	32.9	13.0
45	33.1	13.0
50	33.2	13.1
55	33.4	13.2
60	33.6	13.2
65	33.8	13.3
70	34.0	13.4
75	34.2	13.5
80	34.4	13.5
85	34.7	13.6
90	35.0	13.8
95	35.5	14.0
97	35.8	14.1
98	36.1	14.2
99	36.5	14.4



BITRAGION-CRINION ARC

Subject sits. With the tape passing over the midpoint of the hairline, measure the arc from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear. If there is any appearance of balding in the subject, this measurement is omitted.

Mean: 33.28(.02) cm; 13.10(.01) in.

Standard Deviation: 1.35(.01) cm; .53(.00) in.

Range: 28-39 cm; 11.02-15.35 in.

V = 4.06(.05) % N = 3688

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	29.5	11.6
2	29.9	11.8
3	30.1	11.9
5	30.4	12.0
10	30.9	12.1
15	31.1	12.2
20	31.4	12.4
25	31.6	12.4
30	31.8	12.5
35	31.9	12.6
40	32.1	12.6
45	32.3	12.7
50	32.4	12.8
55	32.6	12.8
60	32.7	12.9
65	32.9	13.0
70	33.1	13.0
75	33.3	13.1
80	33.5	13.2
85	33.7	13.3
90	34.0	13.4
95	34.5	13.6
97	34.9	13.7
98	35.1	13.8
99	35.5	14.0



BITRAGION-MENTON ARC

Subject sits, looking directly forward (head oriented in the Frankfort plane). With the tape passing over the tip of the chin (menton), measure the arc from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 32.45(.02) cm; 12.78(.01) in.

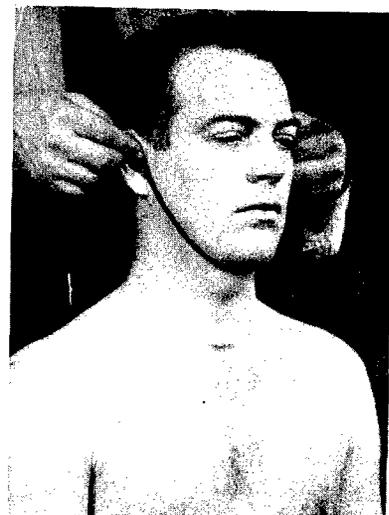
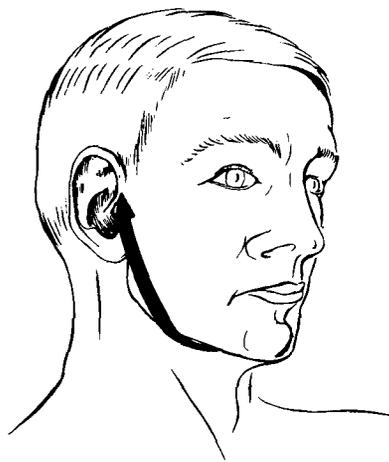
Standard Deviation: 1.28(.01) cm; .50(.00) in.

Range: 27-37 cm; 10.63-14.57 in.

V = 3.94(.04) % N = 4062

Percentile Values

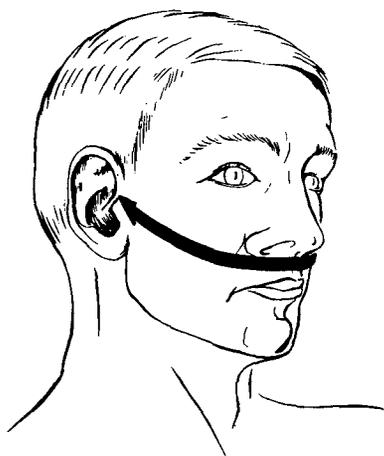
<u>%</u>	<u>CM</u>	<u>IN.</u>
1	27.3	10.7
2	27.7	10.9
3	27.9	11.0
5	28.3	11.1
10	28.8	11.3
15	29.1	11.5
20	29.4	11.6
25	29.6	11.7
30	29.9	11.8
35	30.1	11.9
40	30.3	11.9
45	30.5	12.0
50	30.7	12.1
55	30.9	12.2
60	31.1	12.2
65	31.3	12.3
70	31.5	12.4
75	31.8	12.5
80	32.0	12.6
85	32.4	12.8
90	32.8	12.9
95	33.3	13.1
97	33.8	13.3
98	34.1	13.4
99	34.7	13.7



BITRAGION-SUBMANDIBULAR ARC

Subject sits. With the tape passing under the gonial angles of the jaw and along the juncture of the jaw and the neck, measure the arc from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 30.69(.02) cm; 12.08(.01) in.
 Standard Deviation: 1.57(.01) cm; .62(.00) in.
 Range: 22-37 cm; 8.66-14.57 in.
 V = 5.12(.06)% N = 4063



BITRAGION-SUBNASALE ARC

Subject sits. With the tape passing across the face and just below the nose, measure the arc from the cartilaginous notch (tragion) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

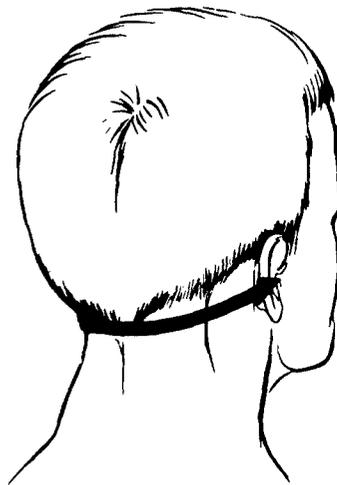
Mean: 29.08(.02) cm; 11.45(.01) in.
 Standard Deviation: 1.10(.01) cm; .43(.00) in.
 Range: 25-33 cm; 9.84-12.99 in.
 V = 3.78(.04)% N = 4056

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	26.7	10.5
2	26.9	10.6
3	27.1	10.7
5	27.2	10.7
10	27.7	10.9
15	27.9	11.0
20	28.1	11.1
25	28.3	11.1
30	28.5	11.2
35	28.6	11.3
40	28.7	11.3
45	28.9	11.4
50	29.1	11.4
55	29.2	11.5
60	29.3	11.5
65	29.5	11.6
70	29.6	11.7
75	29.8	11.7
80	29.9	11.8
85	30.2	11.9
90	30.4	12.0
95	30.9	12.2
97	31.1	12.2
98	31.3	12.3
99	31.6	12.4

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	24.6	9.7
2	24.9	9.8
3	25.1	9.9
5	25.3	10.0
10	25.7	10.1
15	26.0	10.2
20	26.2	10.3
25	26.4	10.4
30	26.6	10.5
35	26.7	10.5
40	26.8	10.6
45	27.0	10.6
50	27.1	10.7
55	27.3	10.7
60	27.4	10.8
65	27.6	10.9
70	27.7	10.9
75	27.9	11.0
80	28.1	11.1
85	28.4	11.2
90	28.7	11.3
95	29.2	11.5
97	29.6	11.7
98	29.8	11.7
99	30.3	11.9



BITRAGION-POSTERIOR ARC

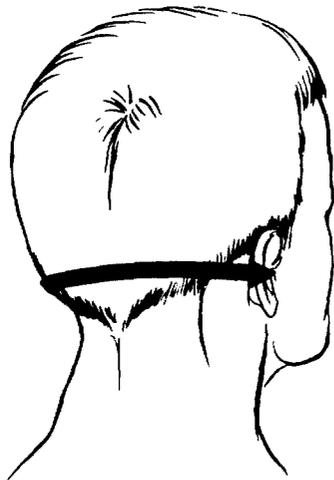
Subject sits, looking directly forward (head oriented in the Frankfort plane). With the tape passing over the lowest point of the skull which can be felt with a finger among the neck muscles, measure the arc from the cartilaginous notch (tragon) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 27.20(.02) cm; 10.71(.01) in.

Standard Deviation: 1.22(.01) cm; .48(.00) in.

Range: 20-32 cm; 7.87-12.60 in.

V = 4.49(.05)% N = 4061



BITRAGION-INION ARC

Subject sits, looking directly forward (head oriented in the Frankfort plane). With the tape passing over inion, measure the arc from the cartilaginous notch (tragon) just forward of the upper edge of the right ear hole to the corresponding notch in the left ear.

Mean: 29.51(.02) cm; 11.62(.01) in.

Standard Deviation: 1.40(.01) cm; .55(.00) in.

Range: 25-37 cm; 9.84-14.57 in.

V = 4.75(.05)% N = 4059

Percentile Values

<u>%</u>	<u>CM</u>	<u>IN.</u>
1	26.7	10.5
2	27.0	10.6
3	27.2	10.7
5	27.5	10.8
10	27.8	11.0
15	28.1	11.1
20	28.3	11.2
25	28.5	11.2
30	28.7	11.3
35	29.0	11.4
40	29.1	11.5
45	29.3	11.5
50	29.5	11.6
55	29.7	11.7
60	29.8	11.8
65	30.0	11.8
70	30.3	11.9
75	30.5	12.0
80	30.7	12.1
85	31.0	12.2
90	31.5	12.4
95	31.9	12.6
97	32.2	12.7
98	32.5	12.8
99	33.0	13.0

SECTION III

AERO-RATING SUBGROUPS

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The data presented in the preceding section were based on men holding a wide variety of aero-ratings. Since some equipment is designed primarily for men with a particular aero-rating, it is of importance to know how well these over-all statistics apply to the individual aero-rating groups of men.

Tests, reported in Appendix B, demonstrate rather conclusively that differences, too large to be attributed to chance variation, do exist among the means and standard deviations of the aero-rating subgroups, at least for the dimensions considered in these tests.

What these tests showed, however, was that these differences were of statistical significance, rather than that they were of practical significance. The question of whether a difference is of practical importance or not cannot be answered once and for all by any kind of test; it can be answered only within the context of each individual problem.

Minimal statistical summaries are given in this section for all dimensions for each of nine aero-rating subgroups. For the engineer who is concerned with a design problem which involves only limited groups of personnel, these summaries can be used

as a guide as to whether or not the subgroup differences are significant—relative, of course, to his particular problem.

For many of the dimensions, particularly those over bone, the differences which appear in these tables are quite small, and the total-group statistics would appear to be applicable to almost all, if not all, design problems. For some of the age-correlated dimensions, which include more flesh, the differences are somewhat larger and the means and standard deviations given here may occasionally prove more satisfactory than those of the preceding section.

For the purposes of this section, the men were grouped into nine subgroups. Those with the rating of pilot-navigator are included in both the multi-engine aircraft pilot and navigator groups, while those with other compound ratings received similar multiple classifications. The composition of the nine groups is given in Table I. (Photographers, flight attendants, and stewards were omitted from these groupings.)

The statistics given here for most of the dimensions are the mean and standard deviation (abbreviated Std Dev in the tables). For a few dimensions, the 1st and 99th percentiles are also given. These two values, taken together, indicate the range of values which includes all but the extreme top and bottom one percents.

Standard errors for the means and standard deviations can be estimated from Table II.

All values (except for weight) are in inches.

Table I

COMPOSITION OF AERO-RATING GROUPS

I. Multi-Engine Aircraft Pilots	N	V. Navigators	N
Pilot, Multi-Engine	1146	Navigator	687
Pilot, Navigator	38	Bombardier, Navigator	228
	<u>1184</u>	Bombardier, Navigator, Radar	58
II. Fighter Pilots		Pilot, Navigator	<u>38</u>
Pilot, Fighter	210		1011
III. Student Pilots		VI. Observers	
Pilot, Student	493	Observer	49
Bombardier, Student Pilot	15	Bombardier, Navigator, Radar	58
	<u>508</u>	Radar Observer	<u>33</u>
IV. Bombardiers			140
Bombardier	144	VII. Flight Engineers	
Bombardier, Navigator	228	Flight Engineer	275
Bombardier, Navigator, Radar	58	Flight Maintenance Technician	245
Bombardier, Student Pilot	15		<u>520</u>
	<u>445</u>	VIII. Gunner	277
		IX. Radio Operators	117

Table II

STANDARD ERRORS FOR SUBGROUP MEANS AND STANDARD DEVIATIONS

Standard Errors for Means											Standard Errors for St'd Deviations										
Group	1.	2.	3.	4.	5.	6.	7.	8.	9.		Group	1.	2.	3.	4.	5.	6.	7.	8.	9.	
0.5	01	03	02	02	02	04	02	03	05		0.5	01	02	02	02	01	03	02	03	03	
1.0	03	07	04	05	03	08	04	06	09		1.0	02	05	03	03	02	06	03	04	07	
1.5	04	10	07	07	05	13	07	09	14		1.5	03	07	05	05	03	09	05	06	10	
2.0	06	14	09	09	06	17	09	12	19		2.0	04	10	06	06	04	12	06	09	13	
2.5	07	17	11	11	08	21	11	15	23		2.5	05	12	08	08	06	15	08	11	16	
3.0	09	21	13	14	09	25	13	18	28		3.0	06	15	09	10	07	18	09	15	20	
4.0	12	28	18	18	14	34	18	24	37		4.0	08	20	13	13	10	24	12	21	26	
5.0	15	35	22	23	17	42	22	30	46		5.0	10	24	16	16	12	30	16	26	33	
6.0	17	41	27	27	20	51	26	36	55		6.0	12	29	19	19	14	36	19	26	39	
7.0	20	48	31	32	24	59	31	42	65		7.0	14	34	22	22	17	42	22	30	46	
8.0	23	55	36	36	27	68	35	48	74		8.0	16	39	25	26	19	48	25	34	52	

(Decimal points omitted)

(Decimal points omitted)

Use of the tables: the standard error of the mean or standard deviation for a particular measurement and subgroup is found in the proper half of the table opposite the value of the standard deviation or an approximately equal one and directly below the group number. Example: the standard deviation for fighter pilots' suprasternale height is 2.06 in. The standard error of the mean value of these heights is thus about .14 in. (read in the second column, opposite 2.0); the standard error of the corresponding standard deviation is similarly found to be about .10 in. (This table underestimates the errors when used with data on bitragion-crinion arc, first Phalanx III and menton-crinion lengths, and substernale and penale heights.)

AERO-RATING SUBGROUP
WEIGHT

	1.	2.	3.	4.	5.	6.	7.	8.	9.
WEIGHT									
Mean	165.7	159.0	159.1	168.6	164.7	166.0	166.4	158.4	156.7
Std Dev	20.5	20.7	17.4	20.6	20.6	22.4	23.3	21.3	19.0
1st %ile	123.0	123.0	122.5	125.8	125.2	113.0	123.5	121.2	115.2
99th %ile	216.5	224.5	198.8	211.2	213.8	216.5	221.8	214.0	199.2

BODY LENGTHS

STATURE									
Mean	69.44	68.81	69.16	69.10	69.21	69.07	68.98	68.31	68.28
Std Dev	2.31	2.24	2.45	2.32	2.46	2.44	2.51	2.43	2.37
1st %ile	64.4	63.8	63.6	63.5	63.5	63.8	63.1	62.4	63.0
99th %ile	74.9	74.2	74.7	74.5	75.0	74.2	75.0	73.7	73.2

TRAGION HEIGHT

Mean	64.26	63.68	64.00	63.92	63.91	63.92	63.85	63.20	63.20
Std Dev	2.29	2.16	2.42	2.26	2.44	2.37	2.43	2.38	2.37

EYE HEIGHT

Mean	65.03	64.50	64.84	64.75	64.73	64.67	64.56	63.83	63.90
Std Dev	2.26	2.19	2.39	2.26	2.40	2.33	2.45	2.33	2.32

NASAL ROOT HEIGHT

Mean	65.30	64.74	65.10	65.00	64.98	64.91	64.80	64.10	64.15
Std Dev	2.26	2.18	2.40	2.26	2.41	2.33	2.48	2.34	2.33

CERVICALE HEIGHT

Mean	59.35	58.71	59.11	59.17	59.24	59.06	59.01	58.30	58.30
Std Dev	2.21	2.09	2.32	2.21	2.33	2.29	2.35	2.31	2.19

SHOULDER HEIGHT

Mean	56.81	56.27	56.51	56.55	56.56	56.56	56.44	55.75	55.74
Std Dev	2.16	2.09	2.28	2.18	2.33	2.24	2.32	2.35	2.17

SUPRASTERNALE HEIGHT

Mean	56.56	55.97	56.30	56.35	56.40	56.22	56.17	55.57	55.50
Std Dev	2.11	2.06	2.20	2.05	2.20	2.11	2.22	2.19	2.16

SUBSTERNALE

Mean	48.90	48.50	49.02	48.49	48.63	48.41	48.62	47.96	47.94
Std Dev	1.94	1.93	2.10	1.89	1.96	1.89	2.01	2.13	2.02

NIPPLE HEIGHT

Mean	50.66	50.25	50.68	50.37	50.43	50.32	50.27	49.76	49.72
Std Dev	2.00	1.90	2.04	1.96	2.12	2.02	2.15	2.05	2.05

NOTE: Weight in pounds; all others in inches.

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers
5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
ELBOW HEIGHT									
Mean	43.73	43.34	43.46	43.55	43.51	43.54	43.46	43.02	42.98
Std Dev	1.69	1.65	1.79	1.68	1.80	1.70	1.79	1.84	1.70
WAIST HEIGHT									
Mean	42.23	41.77	42.01	42.00	42.08	42.02	42.01	41.52	41.62
Std Dev	1.76	1.69	1.81	1.67	1.80	1.79	1.84	1.88	1.83
PENALE HEIGHT									
Mean	34.72	34.52	34.53	34.38	34.52	34.32	34.43	33.97	34.19
Std Dev	1.67	1.64	1.72	1.71	1.78	1.80	1.81	1.84	1.81
WRIST HEIGHT									
Mean	33.72	33.35	33.52	33.61	33.55	33.73	33.40	33.20	33.04
Std Dev	1.48	1.44	1.60	1.46	1.58	1.40	1.55	1.60	1.47
KNUCKLE HEIGHT									
Mean	30.18	29.86	30.08	30.14	30.09	30.22	29.91	29.72	29.54
Std Dev	1.40	1.37	1.51	1.37	1.47	1.32	1.48	1.50	1.28
GLUTEAL FURROW HEIGHT									
Mean	31.70	31.57	31.60	31.57	31.67	31.45	31.49	31.05	31.15
Std Dev	1.58	1.52	1.65	1.57	1.60	1.58	1.66	1.61	1.67
CROTCH HEIGHT (INSEAM)									
Mean	33.10	33.09	33.10	32.82	32.72	32.50	32.76	32.15	32.41
Std Dev	1.68	1.59	1.65	1.66	1.71	1.80	1.79	1.73	1.70
KNEECAP HEIGHT									
Mean	20.29	20.14	20.16	20.19	20.33	20.15	20.17	20.00	19.92
Std Dev	0.98	0.91	1.04	1.00	1.05	1.03	1.04	1.00	1.10
SITTING HEIGHT									
Mean	36.10	35.79	35.91	35.90	35.92	35.94	35.96	35.60	35.59
Std Dev	1.24	1.21	1.30	1.19	1.30	1.27	1.38	1.29	1.21
1st %ile	33.3	32.9	32.6	33.3	32.9	33.3	32.5	32.6	33.0
99th %ile	39.1	38.4	38.9	38.7	39.0	38.5	39.0	38.4	38.4
EYE HEIGHT, SITTING									
Mean	31.65	31.35	31.47	31.52	31.41	31.50	31.50	31.18	31.13
Std Dev	1.24	1.24	1.26	1.17	1.28	1.23	1.32	1.29	1.20
SHOULDER HEIGHT, SITTING									
Mean	23.41	23.17	23.23	23.24	23.21	23.20	23.34	22.92	22.90
Std Dev	1.09	1.03	1.19	1.07	1.14	1.07	1.17	1.14	1.16

1. Pilots(multi-engine plane) 2. Pilots(fighter) 3. Students 4. Bombardiers

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
<u>WAIST HEIGHT, SITTING</u>									
Mean	9.29	9.14	9.15	9.26	9.20	9.23	9.36	9.14	9.20
Std Dev	.74	.71	.76	.72	.76	.72	.80	.80	.84
<u>ELBOW REST HEIGHT, SITTING</u>									
Mean	9.22	9.15	9.17	9.17	9.00	9.13	9.19	8.91	8.89
Std Dev	1.02	.99	1.04	.92	.99	.98	1.11	1.09	1.11
<u>THIGH CLEARANCE HEIGHT, SITTING</u>									
Mean	5.64	5.52	5.58	5.68	5.62	5.62	5.62	5.52	5.54
Std Dev	.52	.50	.50	.52	.52	.59	.55	.55	.49
<u>KNEE HEIGHT, SITTING</u>									
Mean	21.78	21.56	21.68	21.70	21.74	21.56	21.64	21.30	21.35
Std Dev	.96	.94	.97	.93	.98	1.00	1.03	.93	1.03
<u>POPLITEAL HEIGHT, SITTING</u>									
Mean	17.09	17.02	17.08	16.93	16.93	16.81	16.95	16.67	16.74
Std Dev	.74	.70	.72	.75	.77	.82	.79	.76	.85
<u>BUTTOCK-KNEE LENGTH</u>									
Mean	23.75	23.51	23.62	23.68	23.67	23.62	23.57	23.28	23.34
Std Dev	1.03	1.02	1.04	1.06	1.07	1.09	1.09	1.11	1.09
<u>BUTTOCK-LEG LENGTH</u>									
Mean	42.76	42.41	42.75	42.89	42.90	42.77	42.55	42.18	42.35
Std Dev	1.97	1.91	2.04	2.05	2.08	2.06	2.07	2.01	1.88
<u>SHOULDER-ELBOW LENGTH</u>									
Mean	14.36	14.24	14.29	14.27	14.36	14.24	14.35	14.17	14.17
Std Dev	.68	.63	.68	.70	.71	.69	.68	.69	.68
<u>FOREARM-HAND LENGTH</u>									
Mean	18.95	18.75	18.91	18.64	18.87	18.76	18.88	18.65	18.66
Std Dev	.76	.76	.80	.82	.82	.87	.86	.82	.89
<u>SPAN</u>									
Mean	71.15	70.53	70.93	70.62	70.76	70.35	70.83	70.14	70.00
Std Dev	2.80	2.66	2.92	2.89	3.04	2.91	3.00	2.81	3.09
<u>ARM REACH FROM WALL</u>									
Mean	34.69	34.27	34.66	34.73	34.64	34.66	34.63	34.31	34.37
Std Dev	1.61	1.55	1.55	1.57	1.69	1.70	1.71	1.63	1.61

5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

1. 2. 3. 4. 5. 6. 7. 8. 9.

MAXIMUM REACH FROM WALL

Mean	38.78	38.55	38.25	38.71	38.55	38.60	38.82	38.31	38.21
Std Dev	1.91	1.78	1.84	1.85	1.88	1.89	1.86	1.95	1.99

FUNCTIONAL REACH

Mean	32.41	32.04	32.42	32.46	32.45	32.40	32.32	32.00	32.09
Std Dev	1.65	1.52	1.52	1.51	1.61	1.61	1.68	1.60	1.78
1st %ile	28.7	28.8	29.2	28.6	28.7	28.5	28.2	28.2	28.4
99th %ile	36.5	36.1	36.1	35.9	36.3	36.4	36.6	36.6	35.4

BODY BREADTHS AND THICKNESSES

ELBOW-TO-ELBOW BREADTH

Mean	17.47	17.06	16.65	17.59	17.24	17.43	17.62	17.20	17.22
Std Dev	1.41	1.43	1.09	1.40	1.41	1.48	1.53	1.50	1.31

HIP BREADTH, SITTING

Mean	14.06	13.77	13.76	14.15	14.08	14.09	13.98	13.74	13.69
Std Dev	.87	.82	.72	.85	.85	.88	.95	.84	.77

KNEE-TO-KNEE BREADTH, SITTING

Mean	7.95	7.81	7.87	7.98	7.99	7.94	7.92	7.83	7.82
Std Dev	.51	.54	.47	.49	.52	.55	.56	.51	.47

BIACROMIAL DIAMETER

Mean	15.86	15.81	15.95	15.76	15.65	15.66	15.73	15.57	15.47
Std Dev	.73	.69	.71	.71	.76	.69	.72	.68	.79

SHOULDER BREADTH

Mean	18.01	17.75	17.66	18.00	17.86	17.88	17.99	17.76	17.63
Std Dev	.89	.89	.79	.88	.91	.94	.95	.97	.87

CHEST BREADTH

Mean	12.14	11.94	11.81	12.19	12.05	12.05	12.12	11.85	11.86
Std Dev	.77	.83	.69	.83	.81	.85	.86	.80	.77

WAIST BREADTH

Mean	10.69	10.35	10.21	10.84	10.81	10.83	10.83	10.56	10.47
Std Dev	.93	.86	.72	.94	.94	1.04	1.03	.98	.87

HIP BREADTH

Mean	13.24	13.02	13.00	13.35	13.21	13.30	13.24	13.00	12.93
Std Dev	.72	.67	.68	.71	.74	.73	.76	.72	.81

CHEST DEPTH

Mean	9.11	8.91	8.79	9.26	9.11	9.23	9.19	9.01	8.88
Std Dev	.76	.76	.63	.78	.73	.80	.80	.69	.69

WAIST DEPTH

Mean	7.98	7.67	7.43	8.20	8.02	8.16	8.25	7.96	7.84
Std Dev	.80	.81	.62	.90	.88	.87	1.01	.87	.83

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
<u>BUTTOCK DEPTH</u>									
Mean	8.84	8.58	8.42	9.03	8.95	9.00	8.88	8.76	8.65
Std Dev	.79	.78	.62	.84	.80	.81	.94	.87	.77

CIRCUMFERENCES AND BODY SURFACE MEASUREMENTS

<u>NECK CIRCUMFERENCE</u>									
Mean	14.96	14.75	14.87	15.00	15.01	14.95	15.09	14.90	14.82
Std Dev	.73	.77	.68	.72	.71	.72	.87	.74	.70

<u>SHOULDER CIRCUMFERENCE</u>									
Mean	45.55	44.67	44.91	45.42	45.25	45.01	45.55	44.88	44.46
Std Dev	2.39	2.38	2.06	2.37	2.41	2.67	2.62	2.58	2.19

<u>CHEST CIRCUMFERENCE</u>									
Mean	39.21	38.53	37.75	39.46	38.75	39.23	39.25	38.45	38.11
Std Dev	2.34	2.42	1.97	2.48	2.49	2.45	2.61	2.52	2.19
1st %ile	34.1	34.2	33.1	34.0	33.6	33.6	34.0	32.8	33.1
99th %ile	45.0	45.3	43.1	45.4	45.0	44.6	46.1	45.7	43.5

<u>WAIST CIRCUMFERENCE</u>									
Mean	32.28	31.27	30.61	33.01	32.18	32.69	32.82	31.80	31.45
Std Dev	2.92	2.65	2.14	3.13	3.06	3.21	3.43	3.03	2.56
1st %ile	26.6	26.8	26.1	26.9	26.7	26.5	26.5	26.5	26.6
99th %ile	39.6	39.3	36.0	39.5	39.5	39.5	41.4	41.0	37.4

<u>BUTTOCK CIRCUMFERENCE</u>									
Mean	37.97	37.23	37.32	38.34	37.97	38.10	37.87	37.32	37.22
Std Dev	2.29	2.25	1.92	2.24	2.25	2.55	2.51	2.29	2.18

<u>THIGH CIRCUMFERENCE</u>									
Mean	22.51	22.14	22.16	22.64	22.44	22.50	22.45	22.15	22.30
Std Dev	1.74	1.81	1.44	1.69	1.72	1.87	1.83	1.89	1.69

<u>LOWER THIGH CIRCUMFERENCE</u>									
Mean	17.28	16.94	17.31	17.46	17.55	17.40	17.30	17.12	16.99
Std Dev	1.37	1.41	1.23	1.40	1.27	1.37	1.42	1.57	1.39

<u>CALF CIRCUMFERENCE</u>									
Mean	14.49	14.25	14.44	14.52	14.45	14.35	14.33	14.12	13.99
Std Dev	.93	.97	.84	.96	.99	1.07	1.01	.99	.88

<u>ANKLE CIRCUMFERENCE</u>									
Mean	8.95	8.82	8.97	8.95	8.97	9.01	8.89	8.77	8.82
Std Dev	.55	.58	.52	.56	.56	.68	.63	.58	.57

<u>SCYE CIRCUMFERENCE</u>									
Mean	18.21	17.87	17.80	18.31	18.06	18.04	18.29	17.99	18.07
Std Dev	1.36	1.22	1.29	1.36	1.58	1.46	1.35	1.34	1.57

5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

1. 2. 3. 4. 5. 6. 7. 8. 9.

AXILLARY ARM CIRCUMFERENCE

Mean	12.66	12.26	12.17	12.83	12.50	12.72	12.77	12.51	12.42
Std Dev	1.06	1.07	.99	1.05	1.12	1.17	1.14	1.11	1.07

BICEPS CIRCUMFERENCE (FLEXED)

Mean	12.87	12.57	12.51	13.01	12.77	12.83	13.01	12.76	12.71
Std Dev	1.04	1.02	.90	1.07	1.07	1.21	1.12	1.14	1.06

ELBOW CIRCUMFERENCE (FLEXED)

Mean	12.27	12.08	12.29	12.34	12.16	12.34	12.45	12.23	12.19
Std Dev	.74	.80	.70	.79	.84	.91	.81	.85	.89

LOWER ARM CIRCUMFERENCE (FLEXED)

Mean	11.57	11.39	11.42	11.63	11.41	11.42	11.75	11.42	11.34
Std Dev	.73	.67	.64	.72	.74	.74	.79	.73	.71

WRIST CIRCUMFERENCE

Mean	6.84	6.73	6.82	6.84	6.85	6.81	6.95	6.84	6.82
Std Dev	.39	.39	.37	.37	.37	.37	.46	.42	.37

SLEEVE INSEAM

Mean	19.91	19.77	19.92	19.67	19.86	19.65	19.84	19.61	19.56
Std Dev	1.10	1.04	1.05	1.13	1.17	1.05	1.22	1.20	1.20

SLEEVE LENGTH

Mean	33.85	33.95	33.57	33.62	33.65	33.44	33.66	33.26	33.37
Std Dev	1.43	1.44	1.56	1.49	1.52	1.47	1.55	1.35	1.47

ANTERIOR NECK LENGTH

Mean	3.40	3.45	3.41	3.34	3.34	3.54	3.41	3.46	3.45
Std Dev	.63	.54	.60	.66	.65	.68	.68	.68	.62

POSTERIOR NECK LENGTH

Mean	3.70	3.65	3.64	3.50	3.60	3.68	3.56	3.64	3.71
Std Dev	.63	.62	.59	.58	.56	.62	.62	.66	.58

SHOULDER LENGTH

Mean	6.81	6.79	6.81	6.71	6.75	6.74	6.79	6.69	6.77
Std Dev	.55	.53	.53	.54	.56	.54	.59	.55	.63

WAIST BACK

Mean	17.77	17.52	17.55	17.74	17.78	17.70	17.74	17.68	17.62
Std Dev	1.02	.95	1.08	1.05	1.13	1.11	1.09	1.14	.86

WAIST FRONT

Mean	15.28	15.10	15.05	15.38	15.40	15.36	15.16	15.16	14.78
Std Dev	1.10	1.01	1.02	1.10	1.13	.97	1.19	1.20	1.05

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
<u>GLUTEAL ARC</u>									
Mean	11.79	11.65	11.64	11.84	11.73	11.74	11.74	11.51	11.48
Std Dev	.89	.93	.86	.89	.94	.79	.91	1.02	.96
<u>CROTCH LENGTH</u>									
Mean	28.31	27.45	27.88	28.41	28.40	28.40	28.32	27.84	27.99
Std Dev	1.99	1.93	1.89	1.88	1.91	1.96	2.17	2.13	1.92
<u>VERTICAL TRUNK CIRCUMFERENCE</u>									
Mean	65.20	64.17	64.23	65.37	64.91	65.28	64.99	64.26	63.86
Std Dev	2.76	2.86	2.72	2.76	2.88	2.74	3.11	2.91	2.63
<u>INTERSCYE</u>									
Mean	19.73	19.19	19.35	19.72	19.58	19.64	19.88	19.69	19.32
Std Dev	1.37	1.42	1.28	1.41	1.42	1.60	1.34	1.45	1.49
<u>INTERSCYE MAXIMUM</u>									
Mean	22.99	22.41	23.07	22.95	22.86	22.77	22.85	22.57	22.50
Std Dev	1.32	1.31	1.33	1.22	1.30	1.35	1.32	1.35	1.22
<u>BUTTOCK CIRCUMFERENCE, SITTING</u>									
Mean	42.03	41.29	41.23	42.45	41.93	42.11	41.92	40.75	40.72
Std Dev	2.82	2.73	2.18	2.85	2.75	2.98	3.19	2.89	2.80
<u>KNEE CIRCUMFERENCE, SITTING</u>									
Mean	15.52	15.22	15.51	15.52	15.42	15.32	15.30	15.05	15.07
Std Dev	.92	.89	.88	.84	.89	.91	.97	.91	.84
<u>THE FOOT</u>									
<u>FOOT LENGTH</u>									
Mean	10.54	10.45	10.51	10.50	10.52	10.50	10.50	10.38	10.42
Std Dev	.43	.42	.47	.45	.46	.43	.46	.42	.51
<u>INSTEP LENGTH</u>									
Mean	7.66	7.60	7.66	7.63	7.64	7.62	7.64	7.54	7.58
Std Dev	.33	.30	.34	.35	.35	.32	.35	.30	.34
<u>FOOT BREADTH</u>									
Mean	3.81	3.78	3.80	3.79	3.80	3.78	3.82	3.77	3.77
Std Dev	.18	.16	.19	.18	.19	.20	.19	.19	.20
<u>HEEL BREADTH</u>									
Mean	2.65	2.63	2.60	2.64	2.63	2.64	2.68	2.62	2.63
Std Dev	.15	.16	.14	.14	.15	.15	.15	.14	.14
<u>BI-MALLEOLAR BREADTH</u>									
Mean	2.96	2.94	2.95	2.96	2.93	2.94	2.96	2.92	2.92
Std Dev	.15	.14	.16	.14	.15	.15	.15	.15	.16

5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

1. 2. 3. 4. 5. 6. 7. 8. 9.

LATERAL MALLEOLUS HEIGHT

Mean	2.75	2.71	2.71	2.72	2.75	2.74	2.72	2.71	2.69
Std Dev	.22	.22	.22	.22	.22	.23	.22	.22	.24

MEDIAL MALLEOLUS HEIGHT

Mean	3.47	3.44	3.44	3.46	3.47	3.47	3.44	3.42	3.41
Std Dev	.20	.21	.22	.20	.21	.20	.21	.21	.22

BALL OF FOOT CIRCUMFERENCE

Mean	9.68	9.55	9.63	9.64	9.67	9.63	9.72	9.59	9.54
Std Dev	.47	.43	.47	.45	.51	.51	.49	.49	.49

THE HAND

HAND LENGTH

Mean	7.52	7.46	7.49	7.48	7.49	7.49	7.52	7.41	7.40
Std Dev	.32	.33	.33	.34	.34	.35	.35	.33	.38

HAND BREADTH AT METACARPALE

Mean	3.49	3.45	3.47	3.47	3.47	3.47	3.51	3.45	3.45
Std Dev	.15	.15	.17	.16	.17	.16	.16	.17	.15

HAND BREADTH AT THUMB

Mean	4.09	4.03	4.05	4.05	4.08	4.07	4.11	4.05	4.05
Std Dev	.20	.19	.21	.22	.21	.20	.22	.21	.19

THICKNESS AT METACARPALE III

Mean	1.17	1.16	1.17	1.16	1.16	1.16	1.19	1.17	1.17
Std Dev	.07	.07	.06	.07	.07	.07	.07	.08	.08

PALM LENGTH

Mean	4.25	4.21	4.24	4.23	4.25	4.25	4.26	4.20	4.18
Std Dev	.21	.22	.21	.21	.21	.21	.22	.21	.23

FIRST PHALANX III LENGTH

Mean	2.67	2.65	2.67	2.66	2.67	2.67	2.69	2.65	2.63
Std Dev	.11	.11	.12	.12	.12	.13	.12	.12	.13

FINGER DIAMETER III

Mean	.86	.85	.85	.85	.85	.85	.88	.86	.85
Std Dev	.05	.04	.04	.05	.05	.05	.04	.05	.05

GRIP DIAMETER (INSIDE)

Mean	1.92	1.91	1.88	1.90	1.90	1.90	1.89	1.87	1.88
Std Dev	.13	.13	.13	.14	.14	.13	.14	.14	.14

GRIP DIAMETER (OUTSIDE)

Mean	4.11	4.09	4.05	4.11	4.08	4.11	4.11	4.07	4.07
Std Dev	.19	.18	.21	.21	.23	.19	.23	.22	.19

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers

AERO-RATING SUBGROUP

1. 2. 3. 4. 5. 6. 7. 8. 9.

FIST CIRCUMFERENCE

Mean	11.58	11.43	11.54	11.55	11.51	11.52	11.73	11.55	11.45
Std Dev	.57	.53	.57	.51	.56	.51	.58	.57	.58

THE HEAD AND FACE

HEAD LENGTH

Mean	7.80	7.74	7.74	7.76	7.76	7.78	7.76	7.70	7.69
Std Dev	.24	.24	.26	.26	.26	.26	.24	.26	.26
1st %ile	7.25	7.20	7.09	7.19	7.17	7.21	7.19	7.00	7.19
99th %ile	8.33	8.27	8.32	8.38	8.35	8.46	8.31	8.28	8.35

HEAD BREADTH

Mean	6.07	6.08	6.04	6.08	6.08	6.08	6.06	6.02	6.06
Std Dev	.19	.19	.19	.20	.20	.22	.21	.22	.22
1st %ile	5.65	5.63	5.65	5.55	5.60	5.45	5.61	5.52	5.46
99th %ile	6.56	6.59	6.55	6.55	6.57	6.58	6.67	6.50	6.61

MINIMUM FRONTAL DIAMETER

Mean	4.36	4.37	4.37	4.38	4.34	4.32	4.37	4.29	4.30
Std Dev	.19	.17	.18	.19	.19	.23	.20	.20	.19

MAXIMUM FRONTAL DIAMETER

Mean	4.74	4.73	4.71	4.74	4.70	4.68	4.74	4.64	4.66
Std Dev	.19	.17	.19	.19	.19	.23	.21	.21	.20

BIZYGOMATIC DIAMETER

Mean	5.56	5.55	5.51	5.56	5.55	5.56	5.57	5.49	5.49
Std Dev	.19	.19	.19	.20	.20	.23	.21	.20	.21

BIGONIAL DIAMETER

Mean	4.29	4.25	4.25	4.30	4.27	4.29	4.30	4.21	4.23
Std Dev	.22	.21	.20	.21	.22	.22	.22	.22	.21

BITRAGION DIAMETER

Mean	5.61	5.63	5.58	5.60	5.61	5.59	5.60	5.54	5.52
Std Dev	.20	.21	.20	.21	.21	.22	.21	.22	.19

BIOCULAR DIAMETER

Mean	3.77	3.75	3.77	3.78	3.80	3.77	3.76	3.77	3.75
Std Dev	.17	.17	.18	.17	.18	.18	.18	.17	.17

INTEROCULAR DIAMETER

Mean	1.25	1.25	1.24	1.25	1.26	1.25	1.25	1.25	1.24
Std Dev	.10	.10	.10	.09	.10	.10	.10	.10	.11

INTERPUPILLARY DISTANCE

Mean	2.50	2.47	2.48	2.49	2.50	2.50	2.49	2.46	2.49
Std Dev	.14	.13	.13	.13	.15	.14	.15	.14	.14

5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

1. 2. 3. 4. 5. 6. 7. 8. 9.

NOSE LENGTH

Mean	2.02	2.03	1.99	2.00	1.99	2.01	2.00	2.00	2.01
Std Dev	.14	.13	.13	.13	.13	.13	.14	.14	.12

NOSE BREADTH

Mean	1.32	1.29	1.31	1.31	1.33	1.32	1.31	1.30	1.31
Std Dev	.10	.10	.11	.10	.10	.11	.11	.10	.10

NASAL ROOT BREADTH

Mean	.60	.59	.62	.62	.63	.61	.60	.62	.59
Std Dev	.08	.09	.07	.08	.08	.08	.09	.08	.09

NOSE PROTRUSION

Mean	.91	.91	.91	.90	.89	.89	.89	.86	.89
Std Dev	.11	.13	.11	.11	.11	.12	.12	.12	.11

PHILTRUM LENGTH

Mean	.80	.76	.75	.78	.79	.81	.79	.77	.78
Std Dev	.14	.12	.14	.15	.14	.15	.14	.13	.12

MENTON-SUBNASALE LENGTH

Mean	2.65	2.59	2.58	2.60	2.63	2.64	2.64	2.60	2.64
Std Dev	.27	.22	.29	.28	.27	.28	.28	.23	.23

MENTON-CRINION LENGTH

Mean	7.39	7.31	7.37	7.35	7.37	7.37	7.36	7.27	7.35
Std Dev	.36	.34	.36	.35	.35	.37	.37	.35	.31

LIP-TO-LIP DISTANCE

Mean	.63	.65	.69	.61	.63	.62	.61	.64	.65
Std Dev	.12	.11	.12	.12	.13	.14	.12	.12	.12

LIP LENGTH

Mean	2.04	2.04	1.97	2.03	2.02	2.05	2.06	2.03	2.03
Std Dev	.13	.15	.12	.14	.14	.15	.14	.16	.14

EAR LENGTH

Mean	2.48	2.44	2.43	2.48	2.47	2.50	2.49	2.45	2.46
Std Dev	.15	.16	.17	.17	.17	.17	.16	.15	.16

EAR BREADTH

Mean	1.45	1.44	1.42	1.44	1.45	1.45	1.44	1.42	1.45
Std Dev	.10	.10	.10	.11	.11	.10	.11	.10	.12

EAR LENGTH ABOVE TRAGION

Mean	1.17	1.17	1.15	1.17	1.17	1.20	1.18	1.18	1.17
Std Dev	.11	.10	.11	.11	.11	.11	.11	.11	.12

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
<u>EAR PROTRUSION</u>									
Mean	.84	.83	.83	.84	.84	.87	.87	.86	.84
Std Dev	.14	.14	.14	.15	.14	.15	.15	.15	.14
<u>HEAD HEIGHT</u>									
Mean	5.13	5.09	5.01	5.10	5.12	5.17	5.10	5.08	5.11
Std Dev	.31	.32	.32	.28	.29	.31	.27	.28	.30
<u>MENTON PROJECTION</u>									
Mean	1.89	1.86	1.94	1.89	1.86	1.88	1.87	1.83	1.88
Std Dev	.27	.26	.23	.26	.25	.26	.27	.28	.27
<u>EXTERNAL CANTHUS TO WALL</u>									
Mean	6.81	6.77	6.75	6.78	6.77	6.78	6.77	6.74	6.67
Std Dev	.30	.29	.29	.32	.33	.32	.32	.33	.33
<u>NASAL ROOT TO WALL</u>									
Mean	7.80	7.75	7.67	7.74	7.78	7.78	7.73	7.69	7.64
Std Dev	.33	.32	.35	.33	.33	.36	.34	.35	.36
<u>TRAGION TO WALL</u>									
Mean	4.07	4.05	3.99	4.11	4.05	4.12	4.03	4.05	3.96
Std Dev	.30	.27	.29	.27	.28	.29	.30	.31	.31
<u>LARYNX TO WALL</u>									
Mean	6.97	6.87	6.68	7.08	7.05	7.07	7.01	6.90	6.87
Std Dev	.46	.42	.46	.44	.43	.48	.46	.47	.44
<u>HEAD CIRCUMFERENCE</u>									
Mean	22.55	22.37	22.42	22.48	22.52	22.44	22.43	22.30	22.32
Std Dev	.60	.63	.59	.61	.60	.70	.67	.62	.56
<u>SAGITTAL ARC</u>									
Mean	15.13	15.05	15.20	15.06	15.04	14.97	15.06	14.90	14.92
Std Dev	.59	.62	.55	.60	.60	.71	.65	.60	.66
<u>BITRAGION-CORONAL ARC</u>									
Mean	13.85	13.84	13.79	13.80	13.88	13.86	13.81	13.79	13.81
Std Dev	.51	.54	.49	.51	.50	.53	.52	.51	.54
<u>MINIMUM FRONTAL ARC</u>									
Mean	5.43	5.39	5.58	5.45	5.47	5.32	5.45	5.32	5.35
Std Dev	.38	.33	.42	.34	.42	.45	.40	.42	.40
<u>BITRAGION-MINIMUM FRONTAL ARC</u>									
Mean	12.09	12.01	12.01	12.06	12.08	12.10	12.06	11.94	12.00
Std Dev	.45	.46	.43	.44	.44	.51	.43	.42	.43

5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

AERO-RATING SUBGROUP

	1.	2.	3.	4.	5.	6.	7.	8.	9.
<u>BITRAGION-CRINION ARC</u>									
Mean	13.16	13.14	13.11	13.11	13.08	13.17	13.13	12.94	13.02
Std Dev	.52	.49	.51	.53	.52	.56	.55	.56	.54
<u>BITRAGION-MENTON ARC</u>									
Mean	12.83	12.67	12.69	12.79	12.78	12.81	12.86	12.64	12.69
Std Dev	.50	.49	.47	.51	.49	.53	.55	.52	.46
<u>BITRAGION-SUBMANDIBULAR ARC</u>									
Mean	12.17	11.94	11.90	12.11	12.07	12.16	12.19	11.98	12.01
Std Dev	.60	.68	.58	.61	.62	.65	.64	.59	.53
<u>BITRAGION-SUBNASALE ARC</u>									
Mean	11.48	11.39	11.39	11.45	11.47	11.47	11.48	11.34	11.38
Std Dev	.43	.43	.41	.44	.44	.47	.44	.45	.39
<u>BITRAGION-POSTERIOR ARC</u>									
Mean	10.74	10.59	10.60	10.75	10.76	10.73	10.74	10.69	10.61
Std Dev	.46	.47	.44	.46	.49	.53	.51	.49	.42
<u>BITRAGION-INION ARC</u>									
Mean	11.56	11.46	11.60	11.60	11.73	11.73	11.58	11.72	11.54
Std Dev	.53	.47	.51	.49	.54	.62	.58	.64	.53

1. Pilots(multi-engine plane) 2. Pilots(fighter) 3. Students 4. Bombardiers
 5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

SECTION IV

DESCRIPTION AND USE OF THE STATISTICS

The statistical materials given in this report were chosen to provide the simplest and most useful summaries of the two-thirds of a million individual data on which this report is based. A summary of a set of data for any one dimension includes three types of statistics:

(a) an average or measure of what is typical or 'commonplace' among the data;

(b) a measure of variability, that is, a measure of the extent to which the data fluctuate from their average value; and

(c) measures of 'position' or 'order', such as the largest or smallest value, the value below which 10% of the data lie, and related statistics.

Statistics of each of these types are necessary in the handling of design problems.

1. Averages

The mean is the commonest of the averages and is that which is usually meant when the term average is not further specified. The definition of the mean is given by the form of its calculation: the mean of a number of values is the sum of these values divided by the number there are of them. Thus, for example, the weights of 4,052 of the men included in this study add up to 663,150 pounds. The mean of these weights is, therefore, the total (663,150 pounds) divided by the number of men (4,052) or:

$$\text{mean weight} = 663,150 \div 4,052 = 164 \text{ pounds}$$

A second average is the median. This statistic is the 'middle value'. Thus, for example, if all the men were lined up in order from the shortest to the tallest, the height of the middle man in the line would be the median value of the statures. The median is also defined as the 50th percentile. It is not listed separately but is in-

cluded among the other percentiles.

The median and the mean are approximately equal for most of the data represented in this report. As a consequence, the question of whether one or the other is the better average is not a crucial matter for these data.

Mean values are given for all dimensions both for the total series of men and for the aero-rating subseries. Median values are given for all dimensions for the total series of men.

II. Measures of Variability

The standard deviation is the basic measure of variability. If most of a set of data cluster close to their mean value, the standard deviation will be small; contrarywise, if many of the data are much smaller or much larger than the mean, the standard deviation will be large. One useful way of picturing the standard deviation is to consider the middle two-thirds of a set of data. The smallest value in this middle two-thirds will be equal, roughly, to the mean minus the standard deviation; the largest value will be equal, roughly, to the mean plus the standard deviation. (For example: The middle two-thirds of the weights range from about 143 to 184 pounds. The mean is 164 pounds. Assuming the smaller of these values differs from the mean by one standard deviation gives 164 minus 143 or 21 pounds as an approximate value of the standard deviation; using the larger value gives 184-164 or 20 pounds as an approximation to the standard deviation. Both 21 and 20 pounds agree reasonably well with the correct value for the standard deviation, which was 20.86 pounds). Details of the computation of the standard deviation are given in Section V.

The standard deviation is often considered to be the most useful and reliable measure of variability because of the many statistical relationships in which it is involved and because its sam-

pling error is less (for normal and almost normal data) than that of any other measure of variability.

One of these relationships has already been mentioned: that about two-thirds (or better, 68%) of the data fall in a range of which the smallest value is the mean minus the standard deviation, and the largest value is the mean plus the standard deviation. Similarly, about 95% of the data fall in a range whose largest and smallest values are determined by adding and subtracting twice the standard deviation to and from the mean. If the number of standard deviations is increased to three, the resulting range will include virtually all the data.

The coefficient of variation is a restatement of the standard deviation as a percentage of the mean. The relationships of the previous paragraph can be restated in terms of this statistic. If the letter *V* is used to represent the coefficient of variation, then about two-thirds of the values will lie between $(100 - V)$ and $(100 + V)$ percent of the mean value; 95% of them will lie between $(100 - 2V)$ and $(100 + 2V)$ percent of the mean; and almost all of them between $(100 - 3V)$ and $(100 + 3V)$ percent of the mean. For example: two-thirds of the weights, for which $V = 13\%$ (a fairly high value), fall between 87% and 113% of the mean weight. Similarly, two-thirds of the statures, for which $V = 3.5\%$ (a fairly small value), fall between 96.5% and 103.5% of the mean stature.

The range, i.e., the largest value minus the smallest value, is the simplest measure of variability to compute and to comprehend. The two extreme values are given for each set of dimensions; their difference can be quickly determined. (The term 'range' is used both for the pair of extreme values and their difference.) The weakness of the range as a summary statistic is that, being based on the two most untypical values in the set of data, it is exceedingly erratic and has very little sampling stability. The main reason for mentioning the range at this point is to urge that no use be made of it. If a statistic somewhat

similar to the range is desired, the difference between the 1st and 99th percentiles (or some similar pair of percentiles) will serve as a much more reliable measure.

The standard deviation is given for all dimensions for the total series and the subseries. The coefficient of variation and the range are given only for the total series.

III. Measures of 'Position' or 'Order'

Twenty-five percentiles are given for all the dimensions. The fifth percentile for a particular dimension is a value such that 5 percent of the men are smaller than this value, and 95 percent of the men are larger. Ninety-eight percent of the men are smaller than the 98th percentile, and 2 percent are larger. In general, k percent of the men are smaller and $(100 - k)$ percent of the men are larger than the k -th percentile, whatever k may be.

The 50th percentile is also known as the median and serves as one type of average as well as a measure of 'position'.

The principal uses of the percentiles are fairly straightforward. If a doorway is to be designed so that 90 percent of these men can pass through it without stooping, its height should be determined by the 90th percentile of the statures (plus allowance, of course, for shoes and head gear). If some article is to be designed to fit—with the smallest range of sizes—90 percent of the men, it should be designed to fit men whose dimensions range from the 5th to the 95th percentiles, that is, the middle 90 percent.

One fact which the tables of percentiles tend to point up is the high cost—in terms of the range of necessary sizes—of attempting to accommodate the first and last few percent of the men. This is illustrated by the stature data. The total range of statures is from $59\frac{1}{2}$ to $77\frac{1}{2}$ inches, or 18 inches; the central 94% range—from the third percentile to the 97th percentile—is from 64.6 to 73.7 inches, or

about nine inches. The inclusion of the top three percent and the bottom three percent thus gives a range of statures twice as large as the range for the middle 94% alone.

IV. The Standard Errors

Any statistic computed from a sample of data is subject to sampling error. When the sample can be considered as having been randomly selected, it is possible to compute a measure of this sampling error. The usual form that this measure takes is the standard error of the particular statistic. In any one instance, it is impossible to determine what the sampling error is, but the nature of the standard error is such that for two-thirds of a large group of samples, the particular statistic (say, the mean) calculated from the sample will differ from the total group (or 'population') value by less than one standard error. Similarly, in 95 cases out of 100 the sample statistic will be in error less than twice its standard error, and al-

most never will the sampling error exceed three standard errors.

Thus it is reasonable, in any one case, to suppose that the total group value lies within, say, two standard errors of the value calculated from the sample—much more reasonable, in any event, than to suppose that the sample and total group values are identical.

Standard errors are given for the means, the standard deviations, and the coefficients of variation for all measurements for the total series of men. Standard errors for the means and standard deviations of the subseries data can be estimated from Table II, page 78. Standard errors for the percentiles can be estimated from Table III.

Most of the standard errors (except for some of the rather small subseries) are quite small in terms of what would constitute an error of meaningful magnitude. Further discussion of the accuracy of the statistics occurs in Section V.

Table III
STANDARD ERRORS OF PERCENTILES

<u>Percentile</u>	<u>Standard Error</u>
30th through 70th	1.3xSE of Mean
20th, 25th, 75th, 80th	1.4xSE of Mean
15th and 85th	1.5xSE of Mean
10th and 90th	1.7xSE of Mean
5th and 95th	2.1xSE of Mean
3rd and 97th	2.5xSE of Mean
2nd and 98th	2.9xSE of Mean
1st and 99th	3.7xSE of Mean

Example: The standard error of the mean of the weights (p. 11) is 0.33 pounds. Thus, the SE of the 3rd percentile of the weights is $2.5 \times 0.33 = 0.82$ pounds.

SECTION V

STATISTICAL PROCEDURES

Few users of this report will find it necessary to be intimately acquainted with the statistical procedures involved in its preparation. Some users with rather special problems, on the other hand, will find the statistical measures given here of more use if the details of their production are available. Other users, technically equipped to do so, may wish to judge for themselves the adequacy of the procedures. In any event, a detailed account of these procedures has a proper place in this report and is given here.

The computation of all the statistical measures given in this report was done from frequency tables prepared on a punched-card sorter-counter after the original data had been transferred to punched cards. The initial step in the handling of the data was to transfer them to punched cards from the Survey Blank (Fig. 2). Each bodily measurement was punched as a two-digit number, each digit being punched in its own column. This method of punching required the use of four separate cards (cards of four different colors were used to avoid confusion) for each individual.

The method of punching the cards differed slightly, depending on whether the measurement was a large one (such as buttock-leg length) or a small one (such as hand length). The punching of buttock-leg length illustrates the procedure for larger measurements. A measurement of 106.2 centimeters would have been recorded on the field blank:

1	0	6	2
17		18	

In this case, 0 (in column 17) and 6 (in column 18) would be punched. It was not necessary to punch the initial 1 be-

cause, with the values of this measurement running from 90 to 127 cm, it was always clear whether a zero or a one should precede the punched value.* The tenth-of-a-centimeter digit, 2, was simply omitted in the punching; a correction was subsequently made to the calculated values to compensate for this omission.

Smaller measurements—those for which the summary statistics are recorded in millimeters rather than in centimeters—were transferred to the cards by punching the centimeter and tenth-of-a-centimeter digits. A hand length of 21.7 centimeters (217 millimeters) would have been recorded on the field blank as:

2	1	7
37		38

and punched as 1 in column 37 and 7 in column 38. Since the range of hand lengths was from 149 mm to 222 mm, punched values of 00 to 22 were recognized as true values of 200 to 222, and punched values of 49 to 99 as true values of 149 to 199.

The data on the front of the Survey Blank (exclusive of age) were punched according to a code.

The accuracy of the punching was checked by the use of a verifier. Subsequently, all extremely large or small values for any measurements were checked back to the Survey Blank. Dubious values were checked against other measurements of the same individual. Obvious errors were, of course, eliminated. There was an inevitable twilight

*It was necessary, however, to identify the first digit for the weights. This was done by adding an 'x' punch for weights of 200 pounds or more.

zone in which it was impossible to classify with certainty some values, as either being true but somewhat odd, or being erroneous. However, there were few such cases and their inclusion or exclusion had substantially no effect on any of the summary statistics except the range, the instability of which has already been commented on.

Calculation of the means, standard deviations, coefficients of variation, and the standard errors of these statistics were made from the frequency tables with the use of desk calculators. The formulas used were standard ones. Using x to represent a measured value, d to represent the difference between x and an arbitrary (but convenient) value a , f the number of individuals having the same measured x and Σ the summation symbol, these formulas are:

$$\text{Number} = N = \Sigma f$$

$$\text{Mean} = \bar{X} = [\Sigma fx]/N$$

$$\bar{X} = a + [\Sigma fd]/N$$

$$\text{Standard Deviation} = \sigma$$

$$\sigma = \sqrt{([\Sigma fd^2]/N) - ([\Sigma fd]/N)^2}$$

$$\sigma = (1/N) \sqrt{N \Sigma fd^2 - (\Sigma fd)^2}$$

$$\text{Coefficient of Variation} = V$$

$$V = (\sigma/\bar{X}) \cdot 100\%$$

$$\text{Standard Error of the Mean} = SE_{\bar{X}}$$

$$SE_{\bar{X}} = \sigma/\sqrt{N}$$

$$\text{Standard Error of the Standard Devi-}$$

$$\text{ation} = SE_{\sigma} = \sigma/\sqrt{2N} = .707 SE_{\bar{X}}$$

$$\text{Standard Error of the Coefficient of}$$

$$\text{Variation} = SE_V = V/\sqrt{2N}$$

A correction of 0.45 cm was added to the mean for all dimensions for which the last digit was dropped (as, for example, the buttock-leg length dimension described above).

All statistics were computed twice;

where two formulas are listed for a statistic, both were used as a check on the accuracy of the computation.

The means, standard deviations, and their standard errors for all the linear dimensions were converted from centimeters to inches by multiplying them by 0.3937 or from millimeters to inches by multiplying them by 0.03937.

A check on the accuracy of the original frequency tables was obtained when these tables were constructed for the aero-rating subgroups. The subgroup tables were obtained by separating the punched cards by aero-ratings and running each group separately through the sorter-counter. Total series frequency tables were then reconstructed by combining the tables for the subgroups. The frequency tables were considered correct only when the table thus constructed agreed with the original table within 0.1%. The values of Σfx , Σfd , and Σfd^2 , computed from the subgroups, were considered correct only when their respective sums were exactly equal to the same quantities computed for the entire series (modified, if necessary, for slight differences in the card count).

Computation of the statistics for the subgroups was the same as for the total series.

Two of the formulas just mentioned may be open to question. The formula for the standard deviation can be altered by applying Sheppard's correction giving:

$$\sqrt{[\Sigma fd^2/N] - [\Sigma fd/N]^2 - 1/12}$$

The intent of Sheppard's correction is to compensate for errors introduced by grouping the data. The utility of this correction is by no means universally accepted by statisticians; this correction has not been used in the preparation of this report except in the case of grip diameter inside, grip diameter outside, and finger circumference, which dimensions have relatively small ranges because of the units in which they were recorded.

If the standard deviations corrected by Sheppard's formula are desired, they can

be obtained by the use of Table IV.

Table IV

SHEPPARD'S CORRECTION

<u>Standard Deviation</u>	<u>Correction</u>
<u>CM and MM Values</u>	
0.95-1.21 cm(mm)	Subtract 0.04 cm(mm)
1.21-1.68 "	" 0.03 "
1.68-2.78 "	" 0.02 "
2.78-8.33 "	" 0.01 "
8.33- and up	no correction

<u>Values Converted from CM to Inches</u>	
0.27-0.44 inches	Subtract 0.02 inches
0.44-1.29 "	" 0.01 "
1.29 and up	no correction

Values Converted from MM to Inches
no correction

An alternative and presumably more accurate formula for the standard error of the coefficient of variation is:

$$[\frac{V}{\sqrt{2N}}] [\sqrt{1 + 2(\frac{V}{100})^2}]$$

This formula has been used here only for a few of the larger values of V (i.e., those in excess of 10%). The effect of the second factor is trivial: for V = 10%, and N = 4,000 the standard error for V, as computed by the previously given formula, is 0.112; as computed by this formula it is 0.113. For smaller values of V, the differences are still smaller.

The percentiles were computed by two methods. The first method, used for the 10th through 90th percentiles for most measurements, was based on linear interpolation of the cumulative frequency (actually, cumulative percent) tables. The procedure is illustrated by an example. Suppose, for some dimension, 72.3% of the men measured 32 cm or less and 77.7% of the men measured 33 cm or less, the 75th percentile was computed as;

$$\begin{aligned} 32 + (75 - 72.3)/(77.7 - 72.3) = \\ 32 + 2.7/5.4 = 32.50 \text{ cm} \end{aligned}$$

To this figure a correction had to be added since a man whose indicated dimension was 32 cm might actually have measured as much as 32.95 cm. Therefore, in this case the 75th percentile would become:

$$32.5 + 0.95 = 33.45 \text{ cm}$$

and would be so reported. (For data punched in the cards to the nearest millimeter, the correction term was 0.5 millimeters.)

This method was satisfactory for the percentiles in the tenth through 90th percentile range when used with groups as large as the total series and when the number of integral values within this range was reasonably large. This method would have been less satisfactory for the very high and very low percentiles (99th, 98th, 97th, 3rd, 2nd, and 1st), for the smaller groups of several subseries, and for a few of the dimensions such as finger circumference with a small range of integral values. In the first and last of these cases, the problem was that linear interpolation in the cumulative frequency tables failed to provide even a reasonable approximation to reality. Also, in the case of smaller groups (those with an N of less than 1,000) there was clear need for some sort of 'smoothing' of the data.

The high (95th-99th), the low (1st-5th), and a few other percentiles were therefore determined graphically from plots of the cumulative frequencies on 'normal' or 'probability' graph paper. This paper is so designed that the cumulative percentage points lie on a straight line if the data follow a normal distribution.

A typical graph on this type of paper is shown in Figure 7 along with a graph of the same data on ordinary graph paper as the insert. The graph on probability paper, while not a straight line, is a smooth curve with a large radius of curvature at every point. The tails of the curve are stretched out, making differences between, for example, the first and second percentile points quite clear. The graph on ordinary paper, as can be seen, is quite different.

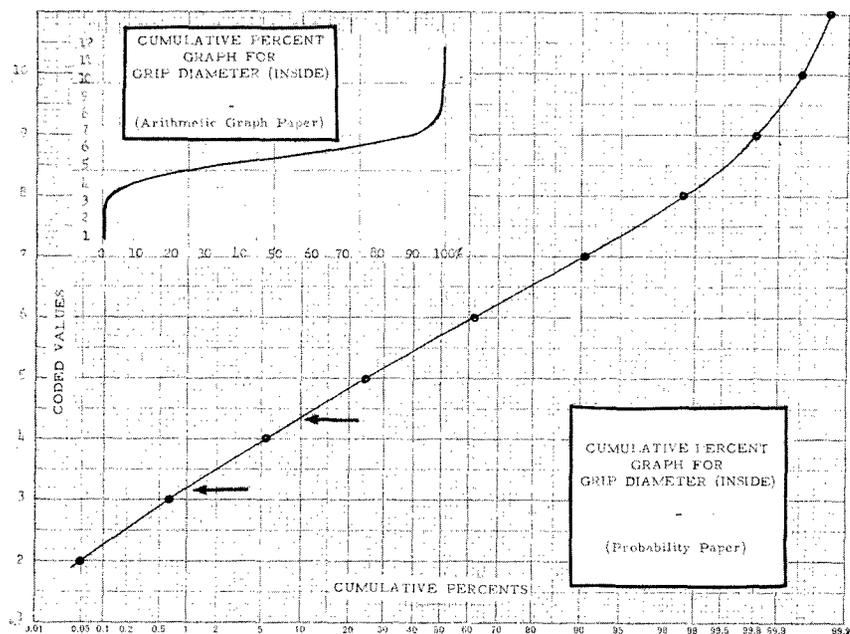


Figure 7. Percentile Graph

There are two sharp bends in the curve and the tails are so nearly vertical that no reasonable identification of such differences between low (or high) percentile points is possible.

The mechanics of this process may, perhaps, become clearer if one notes a few of the plotted values and a few of those read from the graph. The first circled point on the graph represents the fact that 2 or 0.05% of the 4063 men measured 2 or less (coded values), the second circled point similarly represents the fact that 26 or 0.64% of the 4063 men measured 3 or less. The first arrow indicates the point at which the curve crosses the 1% line; the value (3.19) opposite this point on the vertical scale is the 1st percentile. Likewise the value (4.35) opposite the point indicated by the second arrow is the 10th percentile. (Since the values, in this case, were coded ones, these percentile values need to be corrected and decoded.)

A simultaneous check on the calculation of the mean and standard deviation and on the calculation of the percentiles was made by estimating the first two of these statistics from certain of the percentiles. If P_2 designates the 2nd percentile, P_{10} the tenth percentile, and so forth, the formulas for these estimates become:

Estimated Mean =

$$1/6 (P_{98} + P_{90} + P_{80} + P_{20} + P_{10} + P_2).$$

Estimated Standard Deviation =

$$0.12(P_{98} + P_{90} + P_{80} - P_{20} - P_{10} - P_2).$$

Many similar formulas are available.* This pair of formulas appeared, on theoretical grounds, to be about as serviceable as any and worked quite satisfactorily in practice.

Agreement between the directly calculated values and these estimates was, in general, quite good, indicating at least that no major errors had been committed in the computation either of the mean and standard deviation or of these percentiles.

All marked differences were investigated by checking the calculations and the plotting and interpretations of the graph. In a few cases differences of some size occurred which were attributable to marked asymmetry and non-normality of the distributions involved. Even in these cases the comparisons of the estimated and directly calculated values provided some check since the direction of these differences could be determined from the nature of the distribution.

*See e.g., Dixon, W.J., and F.J. Massey. 'Introduction to Statistical Analysis'. New York: McGraw-Hill, 1951.

APPENDIX A

GLOSSARY FOR LAY READERS

- Acromial**—pertaining to acromion.
- Acromion**—the highest point on the lateral edge of the shoulder bone.
- Anterior**—the front part of the body, or pertaining to the front part of the body.
- Axillary**—referring to the armpit region.
- Biceps**—the large muscle at the front of the upper arm.
- Brow Ridge**—the bony elevation covered by the eyebrows.
- Canthus**—a corner or angle formed by the meeting of the eyelids.
- Cervicale**—the largest bony bump on the spinal column in the region of the base of the neck.
- Crinion**—the point in the midplane where the hairline meets the forehead.
- Deltoid Muscle**—the large muscle on the outer side of the upper arm in the shoulder region.
- Distal End**—the end of a limb farthest from the trunk, opposed to proximal.
- External**—away from the central long axis of the body; the outer portion of a body segment.
- Frankfort Plane**—the standard plane of orientation of the head, determined by locating the lower edges of the eye sockets and a single trignon in the same horizontal plane. This can be closely approximated when the subject looks directly forward.
- Glabella**—the most forward point in the midline of the forehead between the brow ridges.
- Gluteal Furrow**—the furrow formed by the overhang of the buttock on the back of the upper leg.
- Gonial Angle**—the angle at the back of the lower jaw formed by the intersection of the vertical portion with the lower edge of the horizontal portion of the jaw.
- Helix**—the rolled outer part of the ear.
- Humerus**—the bone of the upper arm.
- Inion**—a small bony bump often found at the rearmost part of the head.
- Internal**—near the central long axis of the body; the inner portion of a body segment.
- Knuckle**—the joint formed by the meeting of a finger bone (phalanx) with a palm bone (metacarpal).
- Larynx**—the cartilaginous box in the throat which houses the voice mechanism. The 'Adam's Apple' is the most noticeable part of the larynx.
- Lateral**—lying to the right or left side of the midsagittal plane of the body; opposed to medial.
- Lateral Vastus Muscle**—the large muscle on the outside of the upper leg running from just above the kneecap to the hip.

Malleolar—referring to the malleolus.

Malleolus—a rounded bony projection in the ankle region. There is one on both the lateral and medial sides of the leg.

Mandible—the lower jaw.

Mastoid Process—the bony protrusion directly behind the ear.

Medial—lying near the midsagittal plane of the body; opposed to lateral.

Medial Vastus Muscle—the large muscle on the inside of the front of the upper leg running from the kneecap to the hip.

Membranous Lip—the lip of everyday language; the reddish portion of the lip.

Menton—the lower surface of the tip of the chin in the midsagittal plane.

Metacarpal Bone—a bone of the palm of the hand.

Metacarpale—the point of juncture on the back of the hand of the palm bone (metacarpal) with the first bone of the finger (phalanx).

Metatarsal—a bone of the instep of the foot.

Midplane—same as midsagittal plane.

Midsagittal Plane—the plane which divides the body into symmetrical right and left sections.

Nasal Root—the area of greatest indentation where the nose meets the forehead.

Nasal Septum—the cartilaginous wall separating the right nostril from the left.

Natural Waist Line—the level of greatest lateral indentation in the abdomen region. If no Natural Waist Line is visible the level at which the belt is worn is used instead.

Navicular Bone—the small bone of the hand just distal to the bend of the wrist on the thumb side.

Occipital Region—the back of the head.

Olecranon—the bony tip of the elbow.

Patella—the kneecap.

Phalangeal—referring to a phalanx or to the phalanges.

Phalanx—(plural, Phalanges) a bone of the fingers or toes.

Philtrum—the vertical groove running from the upper membranous lip to the base of the nasal septum.

Popliteal Area—the area of the back of the leg directly behind the knee.

Posterior—the back of the body or referring to the back of the body.

Proximal End—the end of a limb nearest the trunk; opposed to distal.

Radial—referring to the radius.

Radius—one of the two forearm bones. This bone runs from the lateral side of the elbow region to the wrist on the same side as the thumb.

Ramus—(plural, Rami) the vertical portion of the lower jaw bone (mandible).

Scye—the sleeve hole.

Sits erect—Subject sits on a flat horizontal surface, his weight distributed equally, with his back held in and his shoulders held back. This position requires holding the torso straight, but not rigid.

Stands erect—Subject stands on a flat surface, his weight distributed equally, with his back held in and his shoulders held back and his legs fully straightened. This position requires holding the body straight but not rigid.

Sternum—the breastbone.

Stylian—the point at the center of the notch just distal to the styloid process of the radius.

Submandibular—under the mandible or lower jaw.

Subnasale—the point where the base of the nasal septum meets the philtrum.

Substernale—the point located at the middle of the lower edge of the breastbone.

Suprasternale—the lowest point of the notch in the upper edge of the breastbone.

Temple Region—the area on the side of the head between eye and ear.

Temporal Crest—a narrow, bony ridge running along the side of the head, curving up from the upper lateral margin of the eye socket, above and past the ear, and downward, ending behind the ear. This serves as the area of attachment for the temporal muscles.

Temporal Muscles—the muscles of the temple region.

Tragian—the point located at the notch just above the tragus of the ear. This point corresponds approximately to the upper edge of the ear hole.

Tragus—the small cartilaginous flap in front of the ear hole.

Trapezius Muscle—the large muscle at the back of the neck and shoulder.

Ulna—one of the two forearm bones; this bone runs from the tip of the elbow to the wrist on the same side as the little finger.

Ulnar—referring to the ulna.

Vastus—see lateral vastus muscle and medial vastus muscle.

Zygomatic Arch—the bony arch running along the side of the cheek almost to the ear.

The group of men on whom this report is based constitute a sample of Air Force personnel on active flying status during the spring and summer of 1950. The selection of this sample and its composition in terms of various sociological and military status factors is described in this appendix. Distributions of data relating to these factors appear in Tables V to XVIII and are discussed below.

I. The Selection of the Sample

Since the data were collected to provide a basis for the design of clothing, equipment, and other aspects of the flight environment of Air Force personnel, it was imperative that the men measured be selected from among those who would actually wear, use, and fit into these items. It was equally imperative that the sampling should be sufficiently broad to include both the younger and older men, to include fighter pilots, bomber pilots, and men with the other aero-ratings as well, to include men from all parts of the country, to include--in short--a sampling of men from every major category which has or might be expected to have serious influence on the dimensional statistics.

Ideally, a stratified random sample should have been measured and the reported statistics obtained by the proper adjustment of the resulting data. The selection and measurement of such a sample would have been virtually impossible and no attempt to get such a sample was made. In addition, no attempt was made to 'adjust' the sample to correspond percentage-wise to its population, i.e., to the group of all Air Force flying personnel, in terms of such factors as age, rank, region of birth, or aero-rating, because the relevant information on the population was not available.

The most satisfactory practical alternative to an ideal sample seemed to be a sample selected by measuring all the available men at a large number of bases of different types at different locations throughout the country. This is, by and large, the nature of the sample used here.

The location of the bases and the number of men measured at each base is described under 'Distribution by Air Force Base'. Studies of this sample, which are reflected in the tables discussed below, indicate that significant differences in bodily dimensions do exist among men of different aero-ratings, among men born in different regions, and among men stationed at different bases.

An examination of the size and nature of these differences suggests two conclusions. First, that these differences are large enough to make essential a broad sampling similar to that used in this survey. Second, that these differences are small enough to justify the conviction that this sample, while undoubtedly not an exact image of the entire Air Force flying personnel, reflects with adequate accuracy the dimensional make-up of the Air Force flying personnel at the time the measuring was done.

II. The Composition of the Sample

The sociological and military status nature of the sample is summarized in Table V which contains distributions of the sample by Air Force base, by rank, by aero-rating, by race, by religion, by marital status, and by education. Distribution of the sample by age appears in Table IX; distributions by birthplace, by mother's birthplace, and by father's birthplace are given in Table X.

A discussion of these data follows. In most cases no exhaustive analysis of the data seemed called for and none was made.

1. Distribution by Air Force Base. The initial plans of the survey called for measuring the personnel at sixteen selected bases. An original goal of a sample of 5,000 had been set so that the aero-rating subgroups obtained would be of reasonable size. The sixteen bases were selected as ones which, (a) would yield both a total sample of the desired size and adequate representation of the important aero-ratings, (b) had sufficient available personnel to justify the setting

up of a measuring center and (c) were sufficiently widespread geographically to provide a reasonable representation of men born in different parts of the country.

The outbreak of the Korean War while the survey was in progress, resulted in the dropping of two eastern bases from the measuring team's schedule. The location of the fourteen bases at which measurements were made appears in Figure 1 (p.2). Distributions of aero-rating, age, education, rank, and region of birth data for the men measured at each base, appear in Tables VIA and VIB. Mean values and ranges for age, weight, stature, and head, chest, and waist circumferences are given in Table VII. The data in these tables point up the importance of including men from many bases wherever a representative sample is desired.

Differences among the distributions of aero-ratings were large, as was to be expected; differences in age and rank were a natural consequence of the differences in aero-rating. (see the discussion of differences among the aero-ratings below); differences in some of the dimensional data were, in turn, related to the differences in age. It is, however, likely that other factors also affected these distributions.

The distribution of region of birth data in Table VI were analyzed to check the assumption that a man's chances of being assigned to a particular base are unrelated to his place of birth. The results of this analysis*, summarized in Table VIII, clearly indicate that assignment and place of birth are related. The first part of this table gives for each base the number of men born in each of the nine geographic regions expressed as a percentage of the total number of native-born men at that base. In many cases, these percentages are close to the corresponding percentages given in the last column of this table for the entire sam-

*The standard chi-square test was used; the resulting value of chi-square, 304 with 104 degrees of freedom, is far beyond those values which might be explained in terms of chance variations.

ple. There were, however, numerous differences of some magnitude.

These larger differences are singled out in the second part of the table. In a number of cases, the proportion of men from a given region was substantially higher at a particular base than it was in the sample as a whole. Each such instance is designated in the table by one or more plus signs in the space corresponding to this base and region. If the proportion of men from one region was substantially smaller at a base than it was in the complete sample, this fact is indicated by one or more minus signs.

A single plus or minus sign indicates a slight discrepancy between the proportion at the indicated base and the proportion in the sample as a whole. Two signs indicate a somewhat larger discrepancy, and three signs a fairly serious discrepancy.

In seven of the eight cases of serious discrepancies, exceptionally large groups of men were stationed at a base located in the same region in which they had been born or at a base in an adjacent region. Thus, 29% of the men measured at Lackland and 28% of those measured at Brooks were from the South-West-Central region, although only 15% of the total sample came from this region. A full quarter of the men at Randolph were born in the South-Atlantic region, as compared with 11% from this region in the total group. The proportion of men from the Pacific-Coast region was three times as high at McChord as in the complete sample (21% as compared with 7%). One man in three at Westover came from the Mid-Atlantic states as compared with one in six in the total group. The Rocky Mountain region was the birthplace of 11% of the men at Lowry but of only 5% of the entire sample.

The eighth serious discrepancy involved the under-representation of men from the Mid-Atlantic region at a base (McChord) the width of the continent away. Sixteen percent of the men in the sample came from this region, but only 6% of the men at McChord did.

2. Distribution by Age. Frequency distributions of ages as of the previous birthday and statistical summaries of age for the total series of men and for the aero-rating subseries appear in Table IX. Further age data are listed under Distribution by Air Force Base.

3. Distributions by Race, Religion, and Marital Status. Distributions of these data have been given in Table V. These data are not further analyzed except for the cross tabulations by aero-rating mentioned below.

4. Distribution by Birthplace. The birthplace data have been grouped on the basis of the Census Bureau's standard division of the United States into nine regions. The birthplaces of the men and of their parents are listed in Table X; this table includes a list of the states comprising each region. Cross tabulations of the birthplaces of the men and their parents appear in Table XII.

No data were obtained on the location of the men's homes for several reasons, one of them being that these locations were determined, for many of the men, by their military assignments. Under these circumstances the birthplace data provide the sole guide to the regional origins of these men.

The birthplace data of the sample are compared in Table XI with the census figures for 1950, the year in which the survey was made, and with the corresponding figures for 1923, the median birthyear of the sample. While neither set of figures provides the best basis for checking whether the sample is geographically representative, this table does indicate that the eastern half of the country is under-represented and the western half overly represented in the present series of men. It is not clear whether this is so because these areas are unequally representative of its population. The reduction, caused by the Korean War, in the number of men measured at eastern bases, may well be largely responsible for these results.

A comparison of mean ages, weights, statures, and chest circumferences of men born in the various regions appears in Ta-

ble XIII. The differences among these means are not particularly large, although they are statistically significant.

A cross tabulation of birthplace and education data appears in Table XIV. Other birthplace data appear in tables listed under Distribution by Air Force Base, Distribution by Rank, and Distribution by Aero-rating.

5. Distribution by Rank. Breakdowns of the sample by rank and cross tabulations of rank and base, rank and birthplace, and rank and aero-rating, are given in Tables V, VI, XV, and XVI.

The four lowest grades are listed here as they were designated at the time of the Survey. These grades are now designated as Airman (Basic), Airman Third Class, Airman Second Class, and Airman First Class.

6. Distribution by Education. The educational level of each man was recorded as the highest grade he had completed. Special training was considered as some course beyond the high school level, such as some type of technician's training. The distribution of the educational levels of the sample is given in Table V. Cross tabulations of education and base (Table VI) and education and birthplace (Table XVI) have been mentioned; the cross tabulation of education and aero-ratings appears in Table XVI.

7. Distribution by Aero-rating. The breakdown by aero-rating appears in Table V. Cross tabulations of aero-rating and base (Table VI), and aero-rating (Table VI), and age (Table IX), have been mentioned. Cross tabulations of aero-ratings and race, religion, rank, marital status, birthplace, and education are given in Table XVI.

The homogeneity of the aero-rating subgroups with respect to their bodily dimensions was investigated in order to determine the need for computing separate statistical summaries for these subgroups. Means and standard deviations for age, weight, stature, and head, chest, and waist circumferences were computed for the different aero-rating groups. These statistics were then tested to determine whether or

not the differences among them exceeded the limits which might be attributed to chance variation.

The differences among the mean values were tested, using the standard analysis of variance test. The results, given in detail in Table XVII, made it clear that the existence of real differences in these variables had to be assumed to exist among the subgroups. This test and the one subsequently made on the differences among the standard deviations were made on the subgroups as they were originally specified, rather than on the subgroups combined according to Table I, in order that no man be involved more than once in any individual test.

A test, similar to that made on the differences among the means, was made on the differences among the standard deviations. The results of this test, also given in detail in Table XVII, were similar to those of the analysis of variance test.

The basic test of the differences among the mean values was the analysis of variance test just described. An additional

series of tests was made by comparing the set of six mean values for each subgroup with the corresponding values for every other subgroup. The results of these tests appear in Table XVIII. In this table plus signs indicate that the mean value of the first-mentioned subgroups was higher than that of the second-mentioned subgroup; minus signs indicate the opposite relationship. One plus or minus sign means the difference was of such a size as to be expected by chance once in 20 times; two signs, once in 100 times; three signs, once in 1000 times.

These tests thus demonstrated that statistically significant differences existed among the dimensional statistics of the aerorating subgroups, at least as far as these six variables were concerned. It seemed reasonable to assume that similar differences existed among many other dimensional statistics. The preparation of separate statistical summaries for the more important aero-ratings thus seemed desirable. These summaries have been given in Section III; the question of whether these differences are of practical, as well as statistical, significance is discussed there.

TABLE V
Distribution of Sample by Base, Rank, Religion, Education, Aero-Rating, Race,
and Marital Status

Distribution by Air Force Base

Base	N	%
Barksdale	425	10.5
Ellington	565	13.9
Bergstrom	97	2.4
Brooks	89	2.2
Lackland	88	2.2
Randolph	807	19.9
March	202	5.0
Mather	720	17.7
Fairfield	297	7.3
McChord	155	3.8
Spokane	282	2.5
Lowry	280	6.9
Selfridge	120	2.9
Westover	116	2.9
	<u>4063</u>	<u>100.1</u>

Distribution by Rank

Group*	N	%
Private	2	.1
Private First Class	13	.3
Corporal	65	1.6
Sergeant	111	2.7
Staff Sergeant	431	10.6
Technical Sergeant	265	6.5
Master Sergeant	70	1.7
Aviation Cadet	606	14.9
Chief Warrant Officer	1	.0
Second Lieutenant	445	10.0
First Lieutenant	1201	29.6
Captain	691	17.0
Major	129	3.2
Lieutenant Colonel	24	.6
Colonel	7	.2
	<u>4063</u>	<u>100.0</u>

Distribution by Religion

Group	N	%
Protestant	3037	74.8
Catholic	914	22.5
Jewish	46	1.1
Other	66	1.6
	<u>4063</u>	<u>100.0</u>

* See note on page 103 relative to designation of four lowest grades.

Distribution by Education

Group	N	%
Read and Write	2	.1
Grade School	113	2.8
High School	1787	44.0
Special Training	207	5.1
College (Completed)	660	16.3
Professional	32	.8
One Year College	339	8.4
Two Years College	602	14.8
Three Years College	318	7.8
	<u>4060</u>	<u>100.1</u>

Distribution by Aero-Rating

Group	N	%
Pilot, Multi-Engine	1146	28.4
Pilot, Fighter	210	5.2
Pilot, Student	493	12.2
Bomb., Nav., Radar	58	1.4
Bomb., Nav.	228	5.7
Observer	49	1.2
Navigator	687	17.0
Bombardier	144	3.6
Radar Observer	33	.8
Flight Engineer	275	6.8
Gunner	277	6.9
Photographer	17	.4
Flight Main. Tech.	245	6.1
Radio Operator	117	2.9
Pilot, Navigator	38	.9
Bomb., Student Pilot	15	.4
Attendant and Steward	7	.2
	<u>4039</u>	<u>100.1</u>

Distribution by Race

Group	N	%
White	4035	99.3
Negro	23	.6
Other	5	.1
	<u>4063</u>	<u>100.0</u>

Distribution by Marital Status

Group	N	%
Single	1137	28.0
Married	2809	69.1
Divorced or Separated	113	2.8
Widower	4	.1
	<u>4063</u>	<u>100.0</u>

Table VI A
Cross Tabulations by Base and by Age and Rank

Group	BASE AND AGE														Total
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
18-19	9						2	1	1						13
20-21	35	120	2			154	5	14	12	10	6	1	7	3	369
22-23	27	112	4	1	1	182	13	29	8	12	13	7	12	8	429
24-25	64	97	14	5	7	190	23	49	47	13	17	38	9	10	583
26-27	78	101	25	6	11	148	54	91	49	32	19	54	17	27	712
28-29	82	53	17	18	23	64	49	141	60	33	16	89	24	30	699
30-31	54	36	16	24	26	30	24	155	51	30	10	47	16	17	536
32-33	41	25	12	14	14	19	21	118	37	15	12	21	17	16	382
34-35	19	15	5	11	4	9	6	98	17	4	7	17	7	4	223
36-37	7	5	1	1		1	2	19	7	1	2	2	3		51
38-39								2	3			1	2		8
40-41	2				2	2		1	2	1					10
42-43	3	1		4				1		3			1	1	14
44-45	1			2									1		4
	<u>422</u>	<u>565</u>	<u>96</u>	<u>88</u>	<u>88</u>	<u>797</u>	<u>199</u>	<u>719</u>	<u>294</u>	<u>154</u>	<u>102</u>	<u>277*</u>	<u>116</u>	<u>116</u>	<u>4033</u>

*Plus one man of 54 years

Group*	BASE AND RANK														Total
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
Private	1											1			2
Private 1st Class	4							1	6	2					13
Corporal	37	2					5	4	9	7	1				65
Sergeant	26	1	3		3		13	15	17	5	7	1	4	14	109
Staff Sergeant	106	30	5	9	2		45	60	72	20	33	14	10	23	429
Technical Sgt.	24	22	4	8	14		9	98	28	17	2	14	16	9	265
Master Sergeant	26		1	9			6		17	3	4		3	1	70
Aviation Cadet		265				337									602
Chief Warrant Ofc.						1									1
2nd Lieutenant	22	82	3	1		195	10	43	8	15	11	13	24	13	440
1st Lieutenant	113	132	51	24	34	184	69	232	82	46	28	136	26	36	1193
Captain	63	29	20	15	23	72	38	211	51	29	15	90	13	16	685
Major		2	9	12	11	7	3	54	3	5		8	11	4	129
Lt. Colonel				7		1	1	1	1	4		2	7		24
Colonel				3						1			2		6
	<u>422</u>	<u>565</u>	<u>96</u>	<u>88</u>	<u>87</u>	<u>797</u>	<u>199</u>	<u>719</u>	<u>294</u>	<u>154</u>	<u>102</u>	<u>278</u>	<u>116</u>	<u>116</u>	<u>4033</u>

Code: 1. Barksdale, 2. Ellington, 3. Bergstrom, 4. Brooks, 5. Lackland, 6. Randolph, 7. March, 8. Mather, 9. Fairfield, 10. McChord, 11. Spokane, 12. Lowry, 13. Selfridge, 14. Westover.

* See note on page 103 relative to designation of four lowest grades.

Table VI B
Cross Tabulations by Base and by Birthplace, Education and Aero-Rating

Group	BASE AND BIRTHPLACE														Total
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
New England	27	34	6	4	1	41	4	33	17	7	5	11	5	12	207
Mid-Atlantic	75	115	6	5	14	122	35	110	45	9	21	35	17	36	645
South Atlantic	52	67	11	9	7	114	12	68	33	11	11	30	12	11	448
East N. Central	84	115	18	15	12	148	35	128	53	22	17	44	40	10	741
East S. Central	32	39	4	11	7	62	11	43	22	6	7	19	8	8	279
West N. Central	72	57	10	7	15	107	37	98	42	32	15	40	19	13	564
West S. Central	46	83	24	26	25	112	31	125	41	20	5	39	14	13	604
Mountain	15	16	6	5	4	43	13	30	18	13	8	31		6	208
Pacific Coast	17	30	9	6	2	46	19	65	23	31	10	25	4	4	291
Foreign	5	13	2	1	1	12	4	16	3	2	3	5	1	2	70
	<u>425</u>	<u>569</u>	<u>96</u>	<u>89</u>	<u>88</u>	<u>807</u>	<u>201</u>	<u>716</u>	<u>297</u>	<u>153</u>	<u>102</u>	<u>279</u>	<u>120</u>	<u>115</u>	<u>4057</u>

Group	BASE AND AERO-RATING														Total
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
Pilots(multi-engine)	83		84	61	67	248	48	100	78	89	24	199	39	63	1183
Pilots (fighter)				1	2	50	40	16	4	3		45	46	2	209
Students						507									507
Bombardiers	31	55		1		16	16	290	17	2	15	2			445
Navigators	61	511	2	1		24	17	335	29	2	22	6		5	1015
Observers	42	1					7	61	17	5	6	1			140
Flight Engineers	60	53	12	17	18		18	159	54	35	10	29	28	29	522
Gunners	113	1					53		77	1	32				277
Radio Operators	31	1	1	3	1		8	20	14	16	6		5	11	117

(Sums of Ratings not equivalent to totals of men because of multiple classifications and omissions. See Table I.)

Group	BASE AND EDUCATION														Total
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
Read and Write	2														2
Grade School	33	13		2	4	1	13	18	14	5	1	3	1	5	113
High School	264	200	51	36	45	251	105	306	170	75	56	109	50	65	1783
Special Training	31	33	9	8	3	34	8	45	11	10	9	7	3	7	207
College(Completed)	51	142	12	33	9	167	20	107	24	15	8	45	17	9	659
Professional	1	2	1	3	1	7	3	6		2	1	1	3	1	32
One Yr. College	16	43	7	2	5	107	20	36	21	9	11	35	20	8	340
Two Yrs. College	22	84	14	4	15	157	19	125	35	29	9	47	18	14	602
Three Yrs. College	5	52	2	1	6	83	13	84	12	8	7	32	8	6	319
	<u>425</u>	<u>569</u>	<u>96</u>	<u>89</u>	<u>88</u>	<u>806</u>	<u>201</u>	<u>716</u>	<u>297</u>	<u>153</u>	<u>102</u>	<u>279</u>	<u>120</u>	<u>115</u>	<u>4057</u>

Code: 1. Barksdale, 2. Ellington, 3. Bergstrom, 4. Brooks, 5. Lackland, 6. Randolph, 7. March, 8. Mather, Fairfield, 10. McChord, 11. Spokane, 12. Lowry, 13. Selfridge, 14. Westover.

Statistical Summary for Six Key Variables for Men Grouped by

Air Force Base

A. F. Base	N	AGE (YEARS)		WEIGHT (POUNDS)		STATURE (INCHES)		CHEST CIRC. (INCHES)		WAIST CIRC. (INCHES)		HEAD CIRC. (INCHES)	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Barksdale	425	28.0	19-45	160.7	113-217	68.9	61.8-75.6	38.6	32.3-47.2	32.0	26.0-43.3	22.4	20.5-24.4
Ellington	565	25.6	20-43	160.9	115-225	69.1	62.2-75.6	38.0	31.9-46.5	31.5	24.8-43.3	22.5	20.5-24.4
Bergstrom	97	28.6	20-37	165.5	129-228	69.0	64.6-75.2	38.9	34.2-44.9	32.6	26.0-47.2	22.6	20.5-23.6
Brooks	89	31.9	23-44	166.0	120-206	68.9	63.4-77.6	38.9	32.3-44.5	33.0	24.8-40.6	22.5	20.9-23.6
Lackland	88	30.0	22-41	168.0	120-265	69.5	64.2-73.6	39.3	33.5-48.4	32.6	27.2-46.9	22.6	21.3-23.6
Randolph	807	25.0	20-36	159.1	110-224	69.2	62.6-76.8	38.0	32.7-46.5	31.0	24.4-41.7	22.4	20.1-24.4
March	202	28.2	19-36	164.7	120-250	68.9	60.6-75.6	39.1	32.3-47.2	32.4	26.4-43.3	22.4	20.1-24.0
Mather	720	30.2	19-42	167.7	110-240	69.2	60.2-77.6	39.4	31.1-48.8	33.0	25.6-42.9	22.5	20.1-24.0
Fairfield	297	29.1	18-41	166.1	104-236	69.2	62.2-76.0	39.5	33.5-46.9	32.6	25.6-40.9	22.5	20.5-24.0
McChord	155	28.6	20-43	164.9	114-227	69.2	61.4-76.8	39.2	33.9-46.4	32.0	26.0-42.1	22.4	20.9-23.6
Spokane	102	27.9	20-37	165.9	125-230	68.8	60.2-74.4	39.5	31.9-49.6	32.3	26.4-40.2	22.5	20.5-23.6
Lowry	280	29.0	21-54	163.6	117-223	69.2	63.4-76.0	39.3	33.9-44.9	34.4	24.4-39.7	22.6	20.9-24.0
Selfridge	120	29.1	21-45	165.2	113-221	68.9	63.8-75.2	39.3	34.2-45.3	32.3	26.8-39.8	22.5	20.9-24.4
Westover	116	28.7	21-43	166.3	128-224	69.2	59.4-76.0	39.0	33.5-44.5	32.3	27.2-39.8	22.4	20.9-23.6

Table VII - Statistical Summary for Six Key Variables for Men Grouped by Air Force Base

TABLE VIII

Air Force Base and Region of Birth

A. Percentages of Men at Each Base Born in Each Region*

Region	Air Force Base														Total Sample
	Barksdale	Bergstrom	Brooks	Ellington	Lackland	Randolph	March	Mather	Fairfield	McChord	Spokane	Lowry	Selfridge	Westover	
New England	7	6	5	6	1	5	2	5	6	5	5	4	4	11	5
Mid-Atlantic	18	6	6	20	16	15	18	16	15	6	21	13	13	32	16
South Atlantic	12	12	10	12	8	14	6	10	11	7	11	11	10	10	11
N.E. Central	20	19	17	21	14	19	17	18	18	15	17	16	34	9	18
S.E. Central	7	4	13	7	8	7	6	6	8	4	7	7	7	7	7
N.W. Central	17	11	8	10	17	13	19	14	14	21	15	15	16	12	14
S.W. Central	11	25	28	15	29	14	15	18	14	13	5	14	12	12	15
Mountain	4	6	6	3	5	5	7	4	6	8	8	11	0	5	5
Pacific	4	10	7	5	2	6	10	9	8	21	10	9	3	4	7

*Based on the 98% of the sample who were born within the forty-eight states.

B. Differences between Percentages at each Base and Percentages in Total Sample Corresponding to Various Values of Chi-Square

Region	Air Force Base													
	Barksdale	Bergstrom	Brooks	Ellington	Lackland	Randolph	March	Mather	Fairfield	McChord	Spokane	Lowry	Selfridge	Westover
New England	+			+	-		-							+
Mid-Atlantic		--	--							---	+	-		+++
South Atlantic						+++	--	-		+				
N.E. Central				+	-							-	+++	--
S.E. Central			++							-				
N.W. Central	+		-	--			+			++				
S.W. Central	--	++	+++		+++			+			--			
Mountain	-	+		--				-		+	+	+++	--	
Pacific	--			-	-	-	+	+		+++	+		-	-

Code = No sign: Difference small, chi-square less than 1.00.

One sign: difference of some size, chi-square greater than 1.00.

Two signs: difference fairly large, chi-square greater than 3.84.

Three signs: difference of considerable size, chi-square greater than 6.64.

+, ++, +++: Greater percentage of men from the indicated region at this base than in sample as a whole.

-, --, ---: smaller percentage of men from the indicated region at this base than in sample as a whole.

Table IX

DISTRIBUTIONS AND STATISTICAL SUMMARIES FOR AGE

AGE	TOTAL SAMPLE	A. Frequency Distributions								
		AERO-RATING SUBGROUP*								
		1	2	3	4	5	6	7	8	9
18-19	13							1	8	3
20-21	370	16	16	142		120		12	36	22
22-23	434	80	46	151	1	107	1	20	17	9
24-25	586	144	33	143	39	141	9	33	54	20
26-27	714	246	44	70	72	164	18	69	74	25
28-29	703	295	39	1	93	148	33	121	38	12
30-31	545	193	13		97	121	29	116	25	17
32-33	382	128	14		71	113	29	72	14	3
34-35	225	60	4		65	89	18	34	6	4
36-37	51	11			4	6	2	24	3	1
38-39	8	2						5	1	
40-41	10	1			1	1		6		1
42-43	14	4	1					6		
44-45	4	3					1	6		
-----									1	
54	1	1								
Total	4060	1184	210	507	443	1010	140	519	277	117

*The sum of the subgroup distributions is not equivalent to the distribution of the total sample because of multiple classifications and omissions. See page 78 for the composition of these subgroups.

GROUP	TOTAL	B. Statistical Summaries								
		AERO-RATING SUBGROUP*								
		1	2	3	4	5	6	7	8	9
Mean	27.87	28.8	26.6	23.6	30.4	27.8	30.7	30.2	26.7	26.4
SE _x	.07	.10	.25	.09	.15	.13	.26	.18	.24	.39
Std. Dev.	4.22	3.5	3.6	2.0	3.1	4.3	3.1	4.0	4.0	4.3
SE _e	.05	.07	.17	.06	.10	.09	.18	.13	.17	.28
V	15.12	12.3	13.4	8.4	10.1	15.3	10.1	13.4	15.0	16.1
SE _v	.17	.25	.67	.26	.34	.34	.60	.42	.64	1.07
N	4060	1184	210	507	443	1010	140	519	277	117

Percentiles

1%	20.4	21.8	20.7	18.9	24.3	19.5	24.2	20.8	19.4	19.1
2%	20.8	22.3	21.2	19.4	24.8	20.1	24.8	21.8	20.0	19.1
3%	21.0	22.8	21.4	19.8	25.1	20.5	25.1	22.6	20.3	19.6
5%	21.3	23.3	21.9	20.2	25.6	21.1	25.7	23.6	20.9	20.5
10%	22.1	24.3	22.6	21.0	26.4	22.1	26.6	25.3	21.9	21.5
25%	24.8	26.2	24.0	22.2	28.1	24.4	28.4	27.8	24.0	23.4
50%	27.7	28.6	26.2	23.6	30.3	27.7	30.6	30.1	26.5	26.0
75%	30.7	31.1	29.0	25.0	32.8	31.4	32.9	32.4	28.7	29.1
90%	33.4	33.4	31.3	26.2	34.3	33.8	34.5	35.1	31.6	32.3
95%	34.6	34.7	32.7	26.8	35.1	34.7	35.4	37.5	33.6	34.0
97%	35.3	35.5	33.6	27.2	35.5	35.2	35.9	38.9	35.0	35.1
98%	36.0	36.1	34.3	27.5	35.8	35.5	36.2	39.9	35.9	35.7
99%	37.7	37.2	35.3	28.0	36.2	35.9	36.7	41.7	37.4	36.6

Code: 1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers
5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

TABLE X

BIRTHPLACES OF SUBJECTS AND THEIR PARENTS

	Subjects		Mothers		Fathers	
	N	%	N	%	N	%
New England States (Me,NH,Vt,Mass,RI,Conn.)	207	5.1	142	3.5	156	3.9
Mid-Atlantic States (NY,NJ,Pa.)	643	15.9	505	12.6	491	12.3
South Atlantic States (Del,Md,DC,Va,WVa,NC, SC,Ga,Fla.)	448	11.1	431	10.8	442	11.1
East North Central States (Ohio,Ind,Ill,Mich,Wis.)	716	17.9	675	16.8	716	17.9
East South Central States (Ky,Tenn,Miss,Ala.)	279	6.9	343	8.6	397	9.9
West North Central States (Minn,Iowa,Mo,ND,SD, Neb,Kans.)	564	13.9	606	15.1	579	14.5
West South Central States (Ark,La,Okla,Texas.)	601	14.8	534	13.1	450	11.3
Mountain States (Mont,Idaho,Wyo,Colo, Utah,Nev,Ariz,NM.)	208	5.1	128	3.2	101	2.5
Pacific Coast States (Cal,Ore,Wash.)	290	7.2	99	2.5	76	1.9
Foreign	71	1.7	553	13.8	590	14.8
Total	<u>4052</u>	<u>100.0</u>	<u>4006</u>	<u>100.0</u>	<u>3998</u>	<u>100.0</u>

TABLE XI

COMPARISON OF BIRTHPLACE DATA WITH 1950 AND ESTIMATED 1923 POPULATION FIGURES

Region	Place of Birth*	1923** Population	1950 Population
New England	5.2%	26.9%	6.2%
Mid-Atlantic	16.2%	21.2%	20.0%
South Atlantic	11.3%	13.1%	14.1%
E.N. Central	18.6%	20.4%	20.2%
E.S. Central	7.0%	8.3%	7.6%
W.N. Central	14.2%	11.6%	9.3%
W.S. Central	15.1%	9.8%	9.6%
Mountain	5.2%	3.1%	3.4%
Pacific	7.3%	5.7%	9.6%
Total	100.1%	100.1%	100.1%

*Based on the 98% of the men who were native born.

**1923 = median year of birth. Population figures estimated by interpolating between 1920 and 1930 census results.

Table XII

**CROSS TABULATION OF SAMPLE BY BIRTHPLACE OF SUBJECTS AND
BIRTHPLACE OF PARENTS**

A. Birthplace of Mother

Birthplace of Subject	New England	Mid-Atlantic	S. Atlantic	E.N. Central	E.S. Central	W.N. Central	W.S. Central	Mountain	Pacific	Foreign	TOTAL
New England	108	14	1	2		1			2	77	205
Mid-Atlantic	13	425	19	20	3	1	2	2	1	147	633
S. Atlantic	3	11	360	14	21	7	4	1	2	21	444
E.N. Central	5	23	15	507	26	33	3	2	3	111	728
E.S. Central	1		11	6	233	5	14			6	276
W.N. Central	2	10	6	50	8	400	19	5	2	48	550
W.S. Central	2	2	8	18	39	50	444	6	2	18	589
Mountain	2	4	2	18	8	48	16	85	3	19	205
Pacific	4	14	7	32	5	54	22	22	80	45	285
Foreign	1	2	1	2		4	3	1	2	53	69
TOTAL	141	505	430	669	343	603	527	124	97	545	3984

B. Birthplace of Father

Birthplace of Subject	New England	Mid-Atlantic	S. Atlantic	E.N. Central	E.S. Central	W.N. Central	W.S. Central	Mountain	Pacific	Foreign	TOTAL
New England	114	8		4	2	6				71	205
Mid-Atlantic	12	396	14	26	4	2	2	4	2	171	633
S. Atlantic	4	23	342	16	20	8	5	1	2	23	444
E.N. Central	11	27	15	486	29	31	4	4		121	728
E.S. Central	1	2	18	8	227	5	9			6	276
W.N. Central	1	14	7	65	14	371	11	4	2	61	550
W.S. Central	5	4	27	25	78	47	381	6	2	14	589
Mountain	2	6	6	27	10	48	15	72	3	16	205
Pacific	4	13	10	51	10	54	20	8	64	51	285
Foreign	2	1	3	4	1	6	3	1		48	69
TOTAL	156	494	442	712	395	578	450	100	75	582	3984

TABLE XIII

STATISTICAL SUMMARY FOR FOUR KEY VARIABLES FOR
MEN GROUPED BY REGION OF BIRTH

BIRTHPLACE	N	AGE (YEARS)		WEIGHT (POUNDS)		STATURE (INCHES)		CHEST CIRC. (INCHES)	
		MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.
New England	207	28.0	4.3	161.7	20.8	68.7	2.5	38.6	2.5
Mid-Atlantic	644	27.5	4.0	162.8	19.4	68.9	2.5	38.7	2.4
South Atlantic	449	27.6	4.2	162.1	20.8	69.1	2.5	38.6	2.5
E. N. Central	741	27.6	4.4	163.0	20.5	68.9	2.3	38.7	2.4
E. S. Central	279	27.8	4.3	163.9	22.2	69.4	2.5	38.8	2.6
W. N. Central	563	28.1	4.2	165.4	21.6	69.4	2.4	39.0	2.5
W. S. Central	600	28.3	4.0	165.0	21.8	69.3	2.3	38.0	2.5
Mountain	208	28.4	4.2	167.3	19.6	69.2	2.5	39.5	2.2
Pacific	290	27.4	4.1	164.6	22.2	69.3	2.6	39.0	2.5
Foreign	71	27.8	4.1	161.2	19.2	69.0	2.7	38.8	2.2

TABLE XIV

CROSS TABULATION OF SAMPLE BY BIRTHPLACE AND EDUCATION

BIRTHPLACE	A	B	C	D	E	F	G	H	I	Total
New England		2	101	13	28	1	17	32	13	207
Mid-Atlantic		13	329	42	96	5	48	72	39	644
South Atlantic		19	170	23	84	7	29	80	36	448
E. N. Central		21	331	44	120	4	56	89	75	740
E. S. Central		11	121	6	50	1	24	48	18	279
W. N. Central	1	12	265	21	87	3	46	86	43	564
W. S. Central		20	254	29	93	5	54	97	51	603
Mountain		6	78	9	37	1	20	35	22	208
Pacific	1	5	107	18	47	3	39	54	17	291
Foreign		4	29	1	16	2	5	9	4	70
Total	2	113	1785	206	658	32	338	602	312	4053

A: Read and Write B; Grade School C: High School D: Special Training
E: College (completed) F: Professional G: One Year of College H: Two Years of College
I: Three Years of College

TABLE XV**Cross Tabulation of Sample by Rank and Birthplace****STATE**

RANK	New England	Mid-Atlantic	S. Atlantic	E. N. Central	E. S. Central	W. N. Central	W. S. Central	Mountain	Pacific	Foreign	TOTAL
Private				1			1				2
PFC	1	1	1	1	3		2		3	1	13
Corporal	7	10	8	13	3	12	3	3	4	2	65
Sergeant	2	29	11	20	6	14	11	3	8	4	108
Staff Sgt.	17	69	41	72	35	59	80	24	26	8	431
Tech. Sgt.	13	28	24	42	25	38	68	12	11	3	264
Master Sgt.		9	9	15	5	10	18		5		71
Aviation Cadet	28	115	78	142	37	72	65	17	42	13	609
Ch. Warr. Ofc.			1								1
2nd Lieutenant	24	63	62	71	32	53	60	29	46	5	445
1st Lieutenant	75	221	121	210	70	184	162	56	80	22	1201
Captain	33	83	78	119	50	102	105	49	56	8	683
Major	6	14	11	28	11	14	25	11	6	4	130
Lt. Colonel		1	2	4	2	4	3	4	4		24
Colonel	1		1	2		2					6
TOTAL	70	207	643	448	739	279	564	602	208	291	4051

TABLE XVI A

Tabulations of Aero-Rating and Race, Religion, and Rank

Group	<u>RACE</u>								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
White	1180	207	500	443	1005	140	516	277	116
Negro	4	3	8	1	5		2		
Other				1	1		2		1
TOTAL	<u>1184</u>	<u>210</u>	<u>508</u>	<u>445</u>	<u>1011</u>	<u>140</u>	<u>520</u>	<u>277</u>	<u>117</u>

Group	<u>RELIGION</u>								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Protestant	941	165	379	317	709	98	409	192	77
Catholic	220	43	114	111	262	38	102	75	37
Jewish	4	1	8	13	23	3	1	1	2
Other	19	1	7	4	17	1	8	9	1
TOTAL	<u>1184</u>	<u>210</u>	<u>508</u>	<u>445</u>	<u>1011</u>	<u>140</u>	<u>520</u>	<u>277</u>	<u>117</u>

Group*	<u>RANK</u>								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Private								2	
PFC								10	3
Corporal			1				8	35	16
Sergeant			1	2	1		30	43	23
Staff Sgt.					1	6	182	170	57
Tech. Sgt.							229	12	16
Master Sgt.					1	3	56	3	2
Av. Cadet			340		266				
Ch. Warr. Off.			1						
2nd Lt.	150	72	130	10	92	3			
1st Lt.	581	85	32	246	394	78	10	2	
Captain	356	42	4	155	209	43	4		
Major	70	7		31	47	7			
Lt. Col.	19	4		1					
Col.	6								
TOTAL	<u>1182</u>	<u>210</u>	<u>508</u>	<u>445</u>	<u>1011</u>	<u>140</u>	<u>519</u>	<u>277</u>	<u>117</u>

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers
 5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

* See note on page 103 relative to designation of four lowest grades.

TABLE XVI B

Cross Tabulations of Aero-Rating and Marital Status, Birthplace of Subject, and Education

Group	<u>MARITAL STATUS</u>								
	1	2	3	4	5	6	7	8	9
Single	162	62	306	41	316	15	85	123	52
Married	992	143	186	391	674	124	418	137	61
Divorced or Separated	30	5	16	11	18	1	16	17	4
Widower				2	3		1		
TOTAL	<u>1184</u>	<u>210</u>	<u>508</u>	<u>445</u>	<u>1011</u>	<u>140</u>	<u>520</u>	<u>277</u>	<u>117</u>

Group	<u>BIRTHPLACE OF SUBJECT</u>								
	1	2	3	4	5	6	7	8	9
New England	63	8	19	26	67	6	18	15	7
Mid-Atlantic	136	31	79	82	206	30	63	52	24
S. Atlantic	116	20	81	54	115	11	51	26	15
N.E. Central	187	46	103	87	200	32	81	54	22
S.E. Central	82	11	41	30	56	7	49	18	6
N.W. Central	189	21	68	58	133	24	66	45	15
S.W. Central	184	36	56	62	114	18	132	36	10
Mountain	90	10	22	13	36	5	25	10	5
Pacific	115	23	31	26	57	5	27	27	8
Foreign	18	4	8	6	22	2	7	4	4
TOTAL	<u>1180</u>	<u>210</u>	<u>508</u>	<u>444</u>	<u>1006</u>	<u>140</u>	<u>519</u>	<u>277</u>	<u>116</u>

Group	<u>EDUCATION</u>								
	1	2	3	4	5	6	7	8	9
Read + Write						1	1		
Grade School	5		1	1	1	2	49	35	13
High School	460	62	141	167	341	57	376	201	88
Spec. Train.	62	3	23	20	53	8	34	17	4
Coll. (compl.)	191	36	129	91	266	27	9	4	1
Professional	14	4	5	3	6	2		8	
1 yr. Coll.	127	32	64	30	73	13	17	11	5
2 yrs. Coll.	221	46	98	74	157	23	28	1	5
3 yrs. Coll.	102	27	47	59	114	7	5		1
TOTAL	<u>1182</u>	<u>210</u>	<u>508</u>	<u>445</u>	<u>1011</u>	<u>140</u>	<u>519</u>	<u>277</u>	<u>117</u>

1. Pilots (multi-engine plane) 2. Pilots (fighter) 3. Students 4. Bombardiers
5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

TABLE XVII

ANALYSIS OF SIX KEY VARIABLES FOR MEN CLASSIFIED
BY AERO-RATINGS

A. Mean Values

GROUP	AGE	WEIGHT	STATURE	WAIST*	CHEST*	HEAD*
1	28.8	165.7	176.4	82.0	99.6	57.3
2	26.6	159.0	174.8	74.4	97.9	56.8
3	23.6	159.1	175.7	77.7	95.9	56.9
4	30.4	168.6	175.5	83.8	100.2	57.1
5	27.8	164.7	175.8	81.7	98.4	57.2
6	30.7	166.0	175.4	83.0	99.6	57.0
7	30.2	166.4	175.2	83.4	99.7	57.0
8	26.7	158.4	173.5	80.8	97.7	56.6
9	26.4	156.7	173.4	79.9	96.8	56.7

Age in years, weight in pounds, other measurements in centimeters

* Circumference

B. Differences among Means: Analysis of Variance Test

Variable	Estimates of Variance			F Values	Degrees of Freedom
	Between	Within	Total		
Age	1,455.72	12.89	17.57	112.93	13 and 3998
Stature	223.71	37.38	37.97	5.99	13 and 4000
Weight	4,225.05	422.81	435.25	10.06	13 and 3991
Chest*	685.43	36.63	38.74	18.71	13 and 3996
Waist*	1,094.15	55.66	59.02	19.66	13 and 3995
Head*	13.89	2.43	2.47	5.71	13 and 3994

All values of F significant at 0.001 level.

C. Differences among Standard Deviations: L_1 Test

	$N \log_e \sigma^2$	$\sum n_i \log_e \sigma_i^2$	Difference
Age	10,258.3	9,850.1	408.2
Weight	24,217.1	24,148.6	68.5
Stature	14,531.9	14,478.2	53.7
Chest*	14,439.0	14,366.6	72.4
Waist*	16,111.1	15,950.1	161.0
Head*	3,565.9	3,536.0	29.9

Note: The differences can be interpreted as Chi-square values with 13 degrees of freedom. The 0.01 value is 27.7, the 0.001 value is 34.5.

* Circumference

1. Pilots (multi-engine planes) 2. Pilots (fighter) 3. Students 4. Bombardiers
5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

TABLE XVIII

SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN VALUES OF SIX KEY VARIABLES FOR MEN CLASSIFIED BY AERO-RATINGS

Aero-Rating Groups	Age	Chest*	Waist*	Head*	Stature	Weight
1:2	+++	+++	+++	+++	+++	+++
1:3	+++	+++	+++	+++	+	+++
1:4	---	o	---	+	--	-
1:5	+++	+++	o	o	+	o
1:6	---	o	---	o	o	---
1:7	---	o	---	+++	+++	o
1:8	+++	+++	+	+++	+++	+++
1:9	+++	+++	++	+++	+++	+++
2:3	+++	+++	++	o	o	o
2:4	---	---	---	--	--	---
2:5	---	---	---	-	-	---
2:6	---	--	---	o	o	--
2:7	---	---	---	o	o	---
2:8	o	o	o	o	+	o
2:9	o	o	o	o	o	o
3:4	---	---	---	--	o	---
3:5	---	---	---	o	o	---
3:6	---	---	---	o	o	---
3:7	---	---	---	o	o	---
3:8	---	---	---	++	+++	o
3:9	---	o	--	o	+++	o
4:6	o	o	o	o	o	o
4:7	o	o	o	o	o	o
4:8	+++	+++	+++	+++	+++	+++
4:9	+++	+++	+++	+	++	+++
5:4	---	---	---	o	o	o
5:6	---	o	o	o	o	o
5:7	---	---	---	+	o	o
5:8	+++	+	o	+++	+++	+++
5:9	+++	++	+	++	+++	+++
6:7	o	o	o	o	o	o
6:8	+++	+++	++	+	++	+++
6:9	+++	+++	+++	o	++	+++
7:8	+++	+++	+++	++	+++	+++
7:9	+++	+++	+++	o	++	+++
8:9	o	o	o	o	o	o

***Circumference**

1. Pilots (multi-engine planes) 2. Pilots (fighter) 3. Students 4. Bombardiers
5. Navigators 6. Observers 7. Flight Engineers 8. Gunners 9. Radio Operators

Code: Plus signs indicate that the group listed first in the left column had a larger mean value than the group listed second. Minus signs indicate that the latter group had the larger mean value.

- o: the difference was not significant
- + or -: the difference was significant at 5% level
- ++ or --: the difference was significant at 1% level
- +++ or ---: the difference was significant 0.1% level

APPENDIX C - MARKED POINTS

- A.** Acromion - Subject stands erect. Feel for and mark the highest point on the lateral edge of the shoulder bone.
- B.** Cervicale - Subject stands erect with his head oriented in the Frankfort plane. Feel for and mark a point on the most prominent bony bump at the base of the back of the neck. If there is difficulty in locating this point, have the subject bend his neck and head forward, locate the point, and mark it after the head is returned to the Frankfort plane.
- C.** Neck Point - Subject stands erect with his head oriented in the Frankfort plane. Standing behind the subject mark the point where the large muscle of the back of the shoulder (the trapezius) joins the column of the neck.
- D.** Scye Points - Subject stands erect, arms hanging naturally at his sides. Standing behind the subject, mark on the left and right sides the highest point in the crease formed by the juncture of the arm and trunk.
- E.** Substernale - Subject stands erect. Feel for and mark the lowest point on the breast-

bone in the midsagittal plane.

- F.** Suprasternale - Subject stands erect. Feel for and mark the lowest point of the notch in the upper edge of the breastbone.

- G.** Waist Marks - Subject stands erect. Locate the natural waistline, the level of greatest lateral indentation in the region of the abdomen. If the natural waistline is not visible, determine the level at which the belt is worn. Then make the following marks at this waist level:

(1) Anterior Waist Point - the point at which the waist level crosses the midsagittal plane in the front.

(2) Lateral Waist Points - the most lateral points at the waist level on the left and right sides.

(3) Posterior Waist Line - a line directly above the middle of the right buttock at the waist level.

(4) Posterior Waist Point - the point at which the waist level crosses the midsagittal plane in the back.

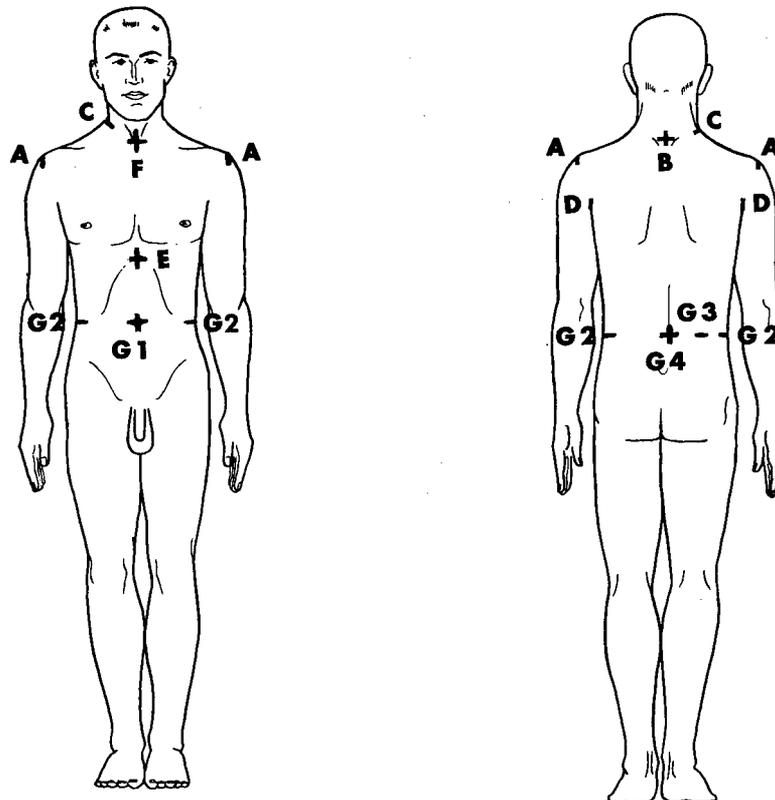


Figure 8. Marked Anatomical Points

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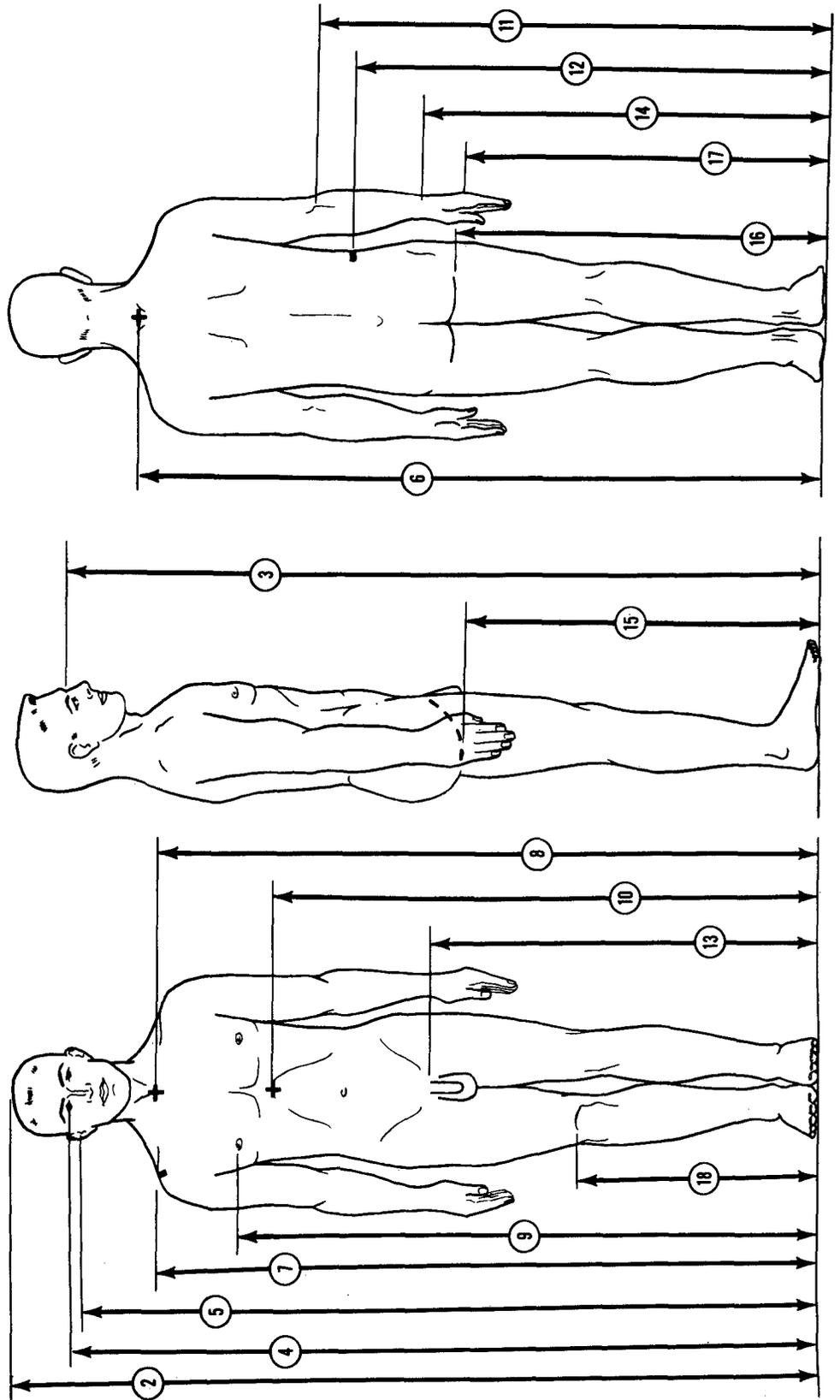
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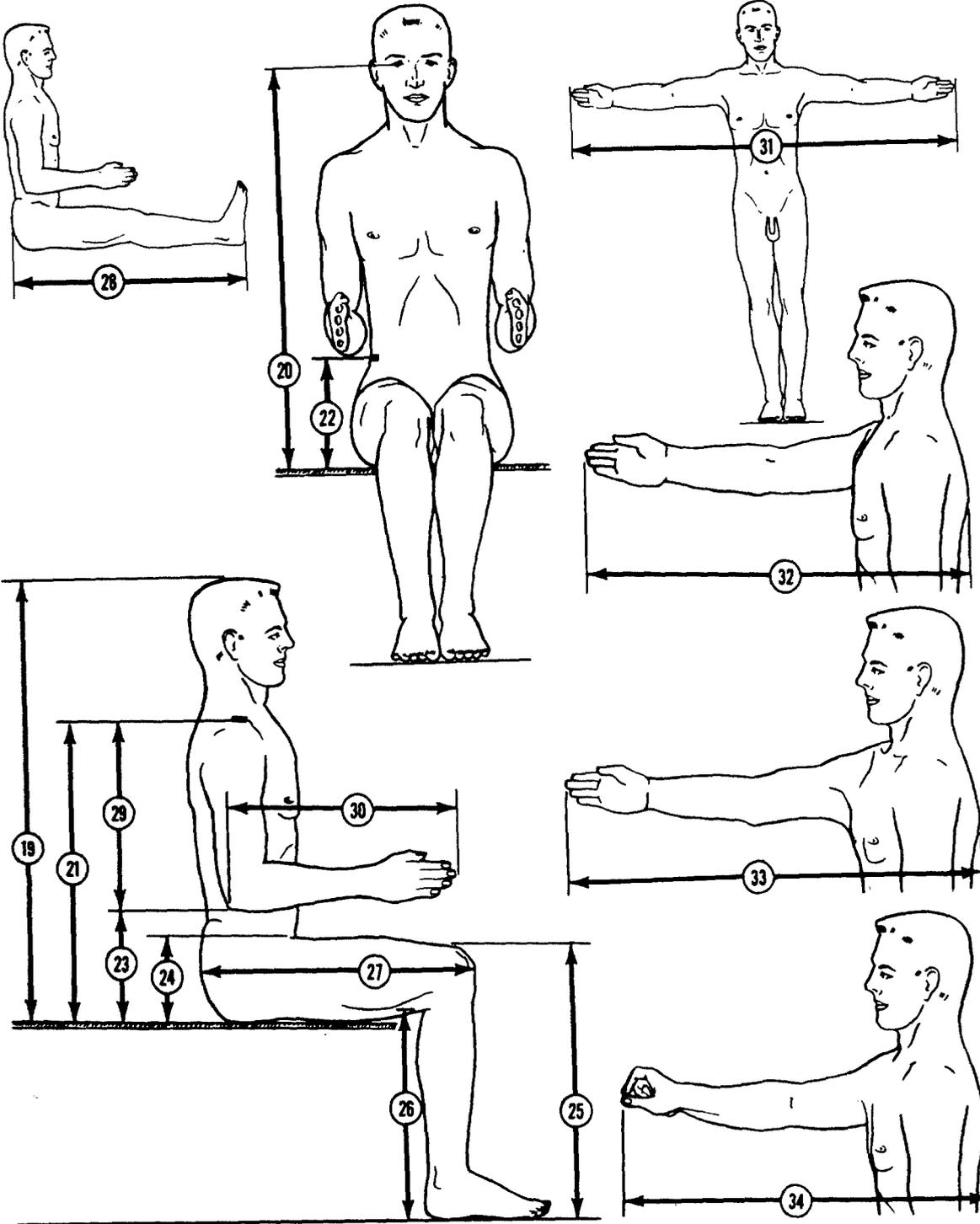


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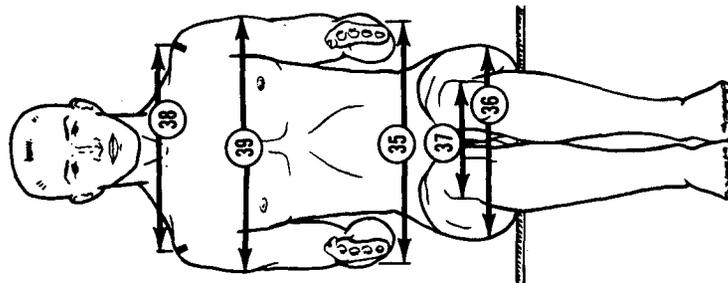
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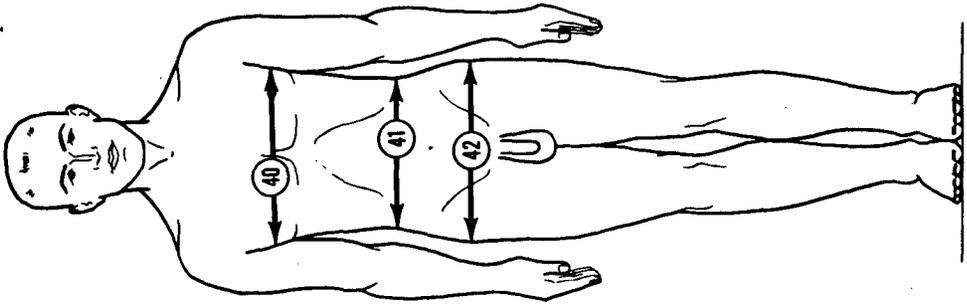


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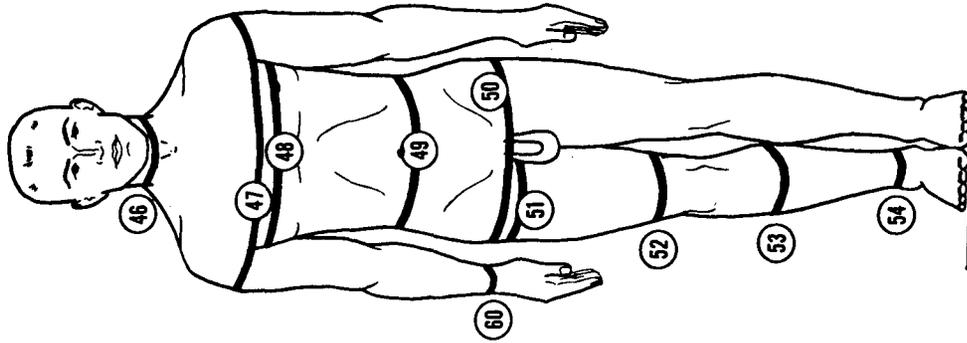
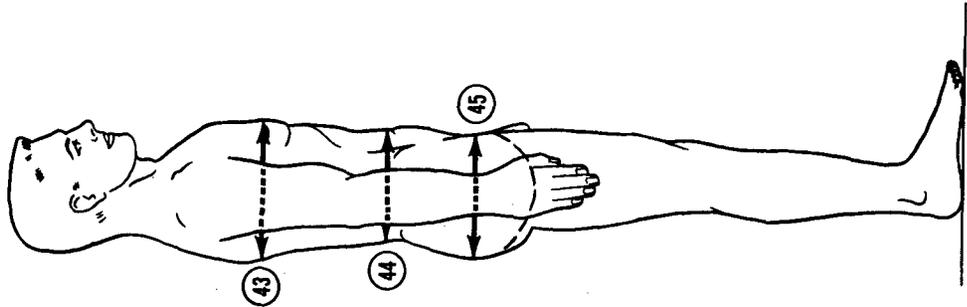


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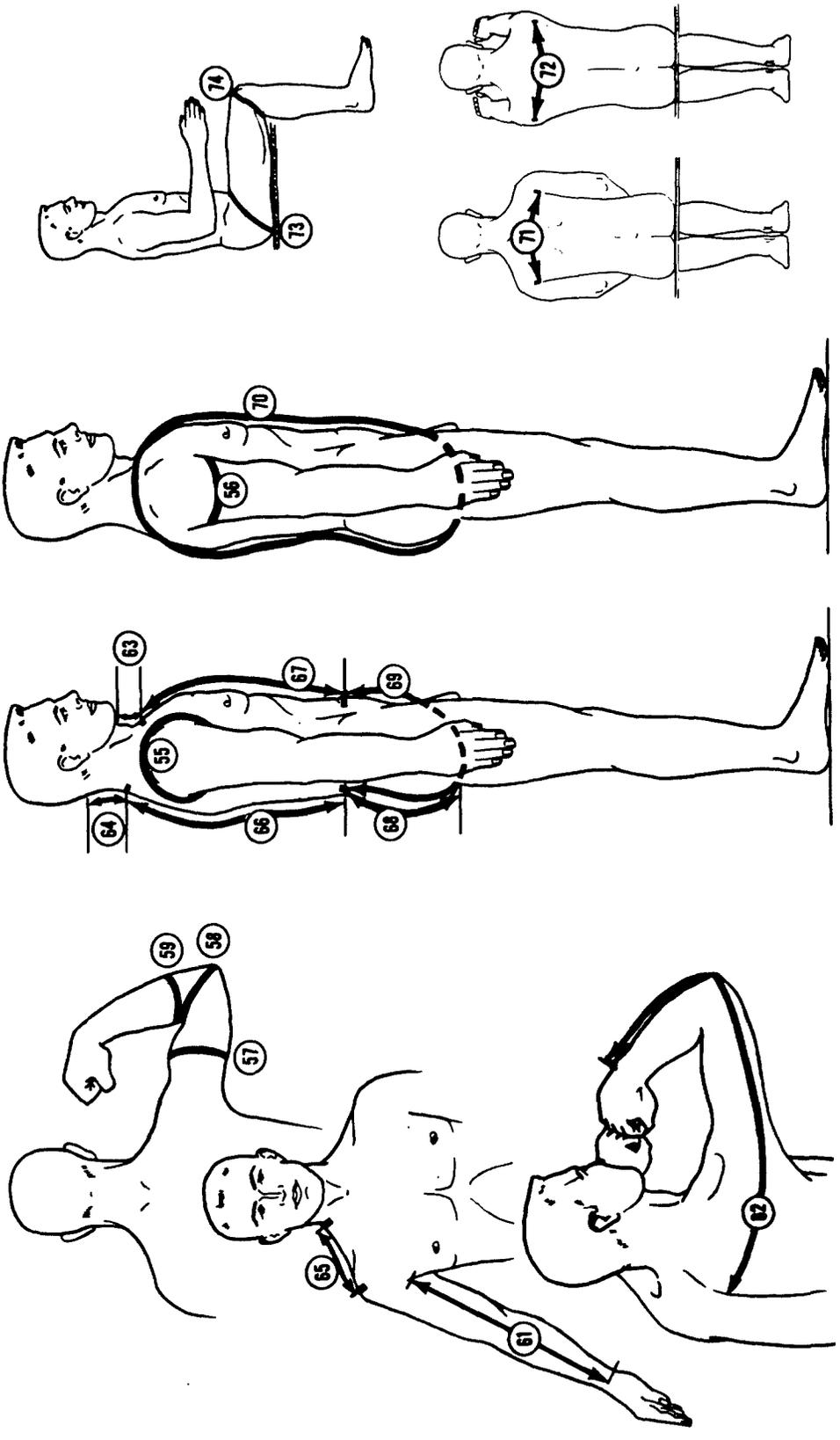
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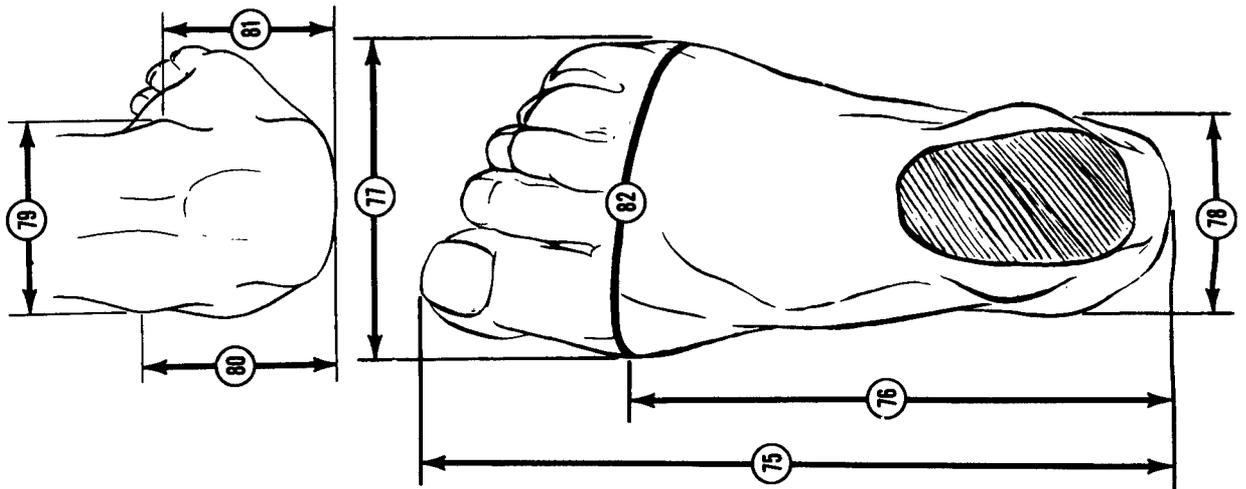
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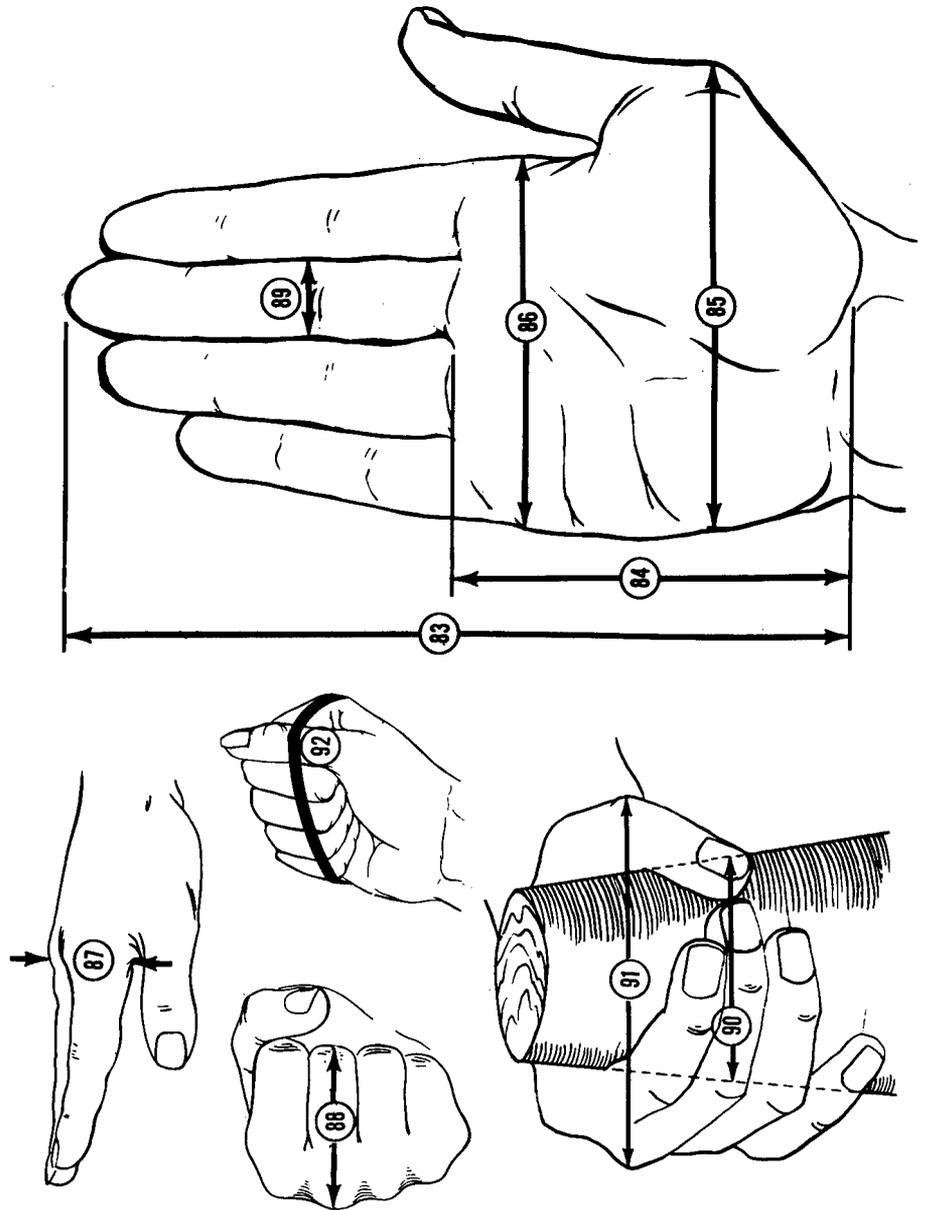
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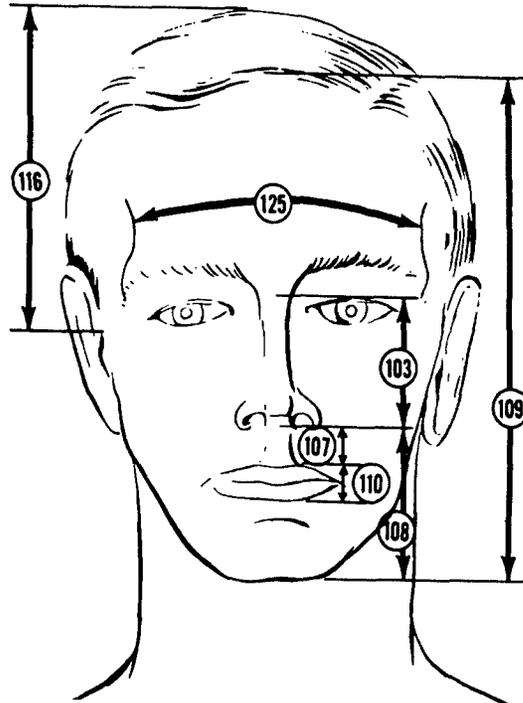
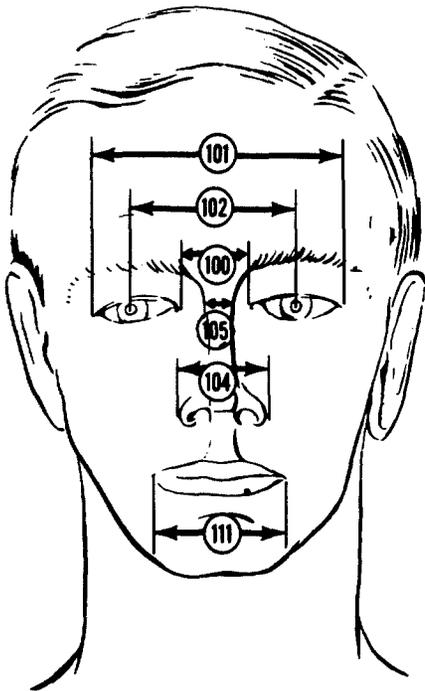
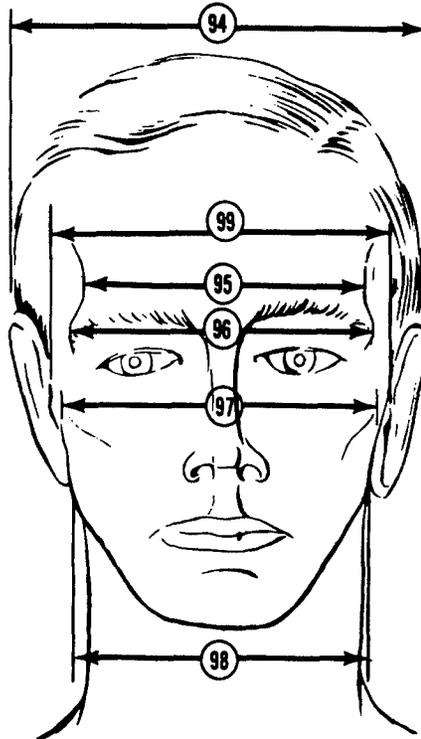
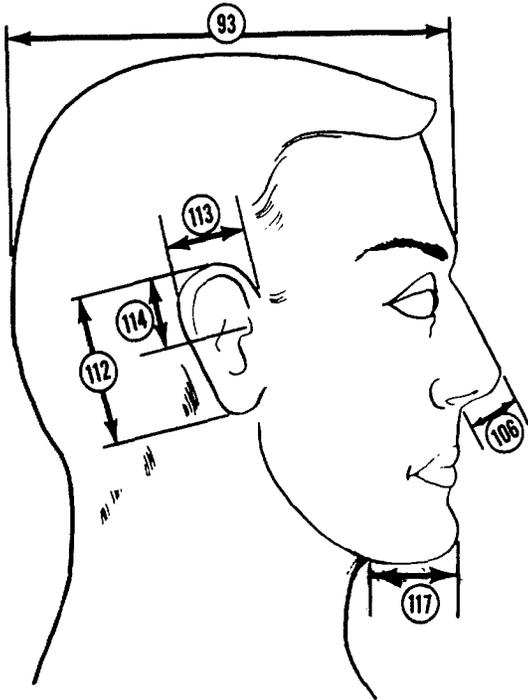
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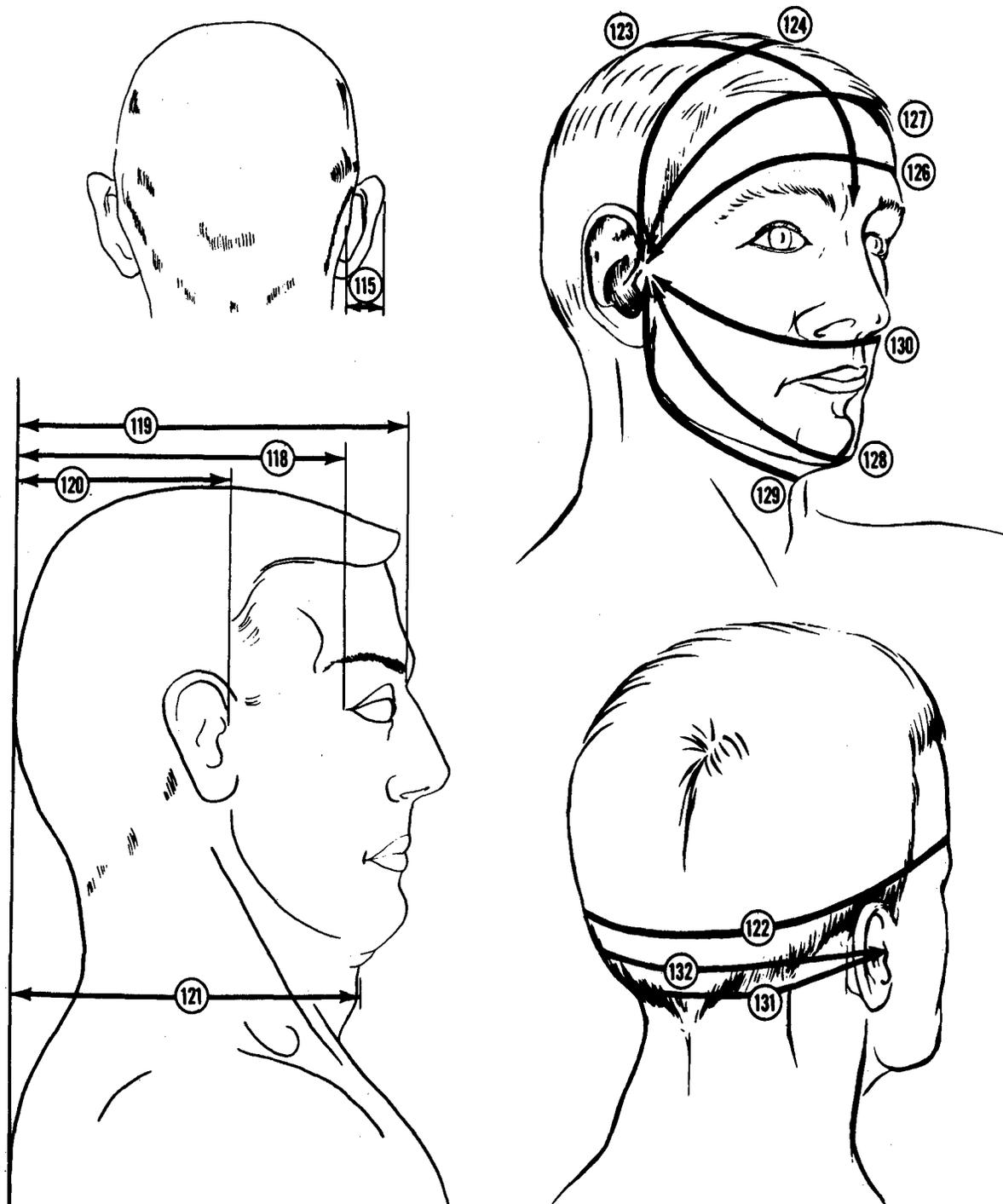
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